June 15, 1959

Aviation Week

Including Space Technology

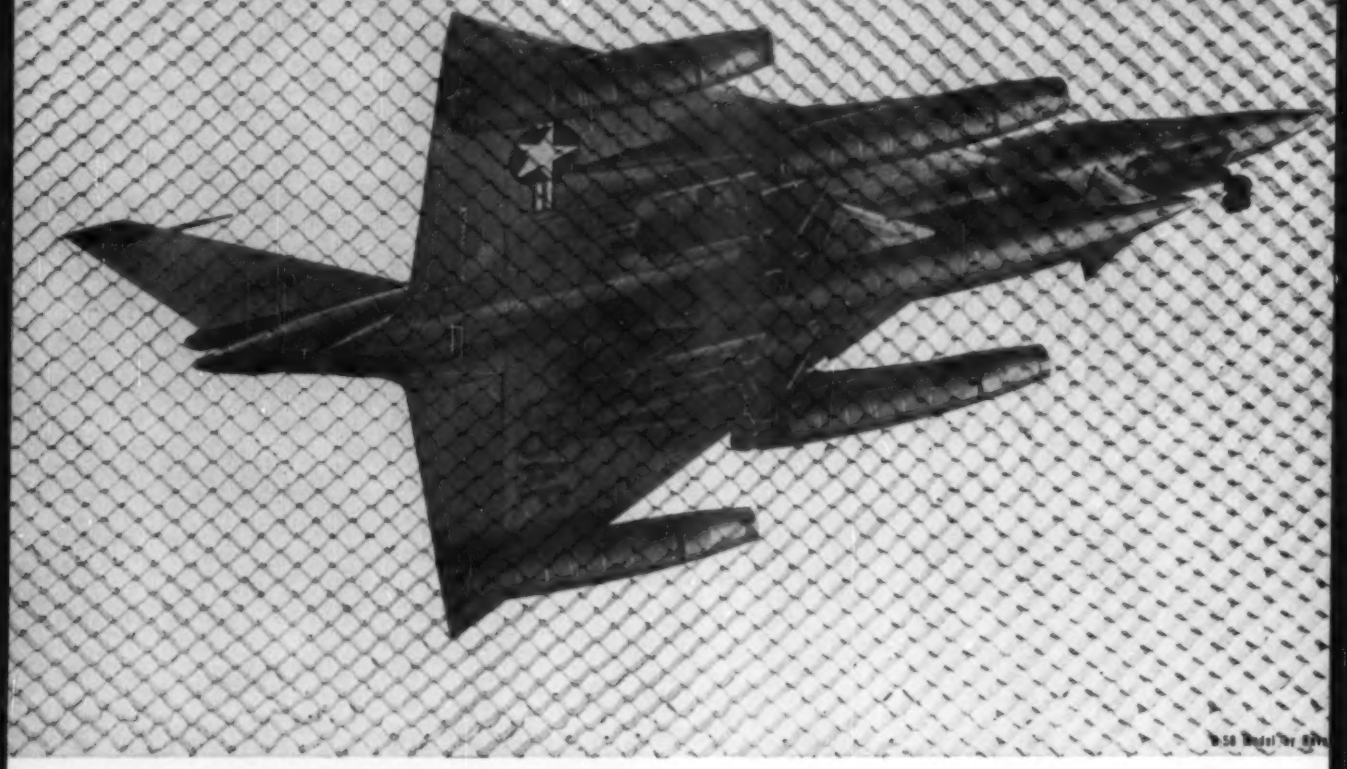
A McGraw-Hill Publication

Lockheed Pushes Production Of C-130 in Europe

Boeing IM-99B Bomarc

HUNGRY FOR HONEYCOMB SANDWICHES...

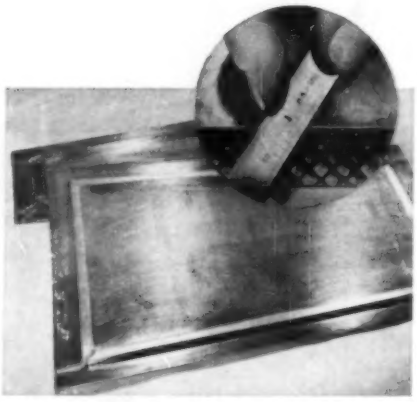
B-58 SELECTS RHEEM



When Convair was looking for a reliable source for welded, stainless steel honeycomb sandwiches for the nacelles of the B-58, it was necessary to demand a superior product for such an important Air Force project. One of the sources investigated was Rheem—a company renowned for more than a decade for its experience in difficult metalworking projects for the aircraft and missile industries.

Critical welding and brazing operations to extremely demanding specifications were not new to Rheem's Defense and Technical Products Division. In a short period of time, the Downey California plant was busy turning out just the kind of stainless steel honeycomb sandwiches required for Convair's proud, new, B-58 supersonic bomber, the Air Force Hustler.

If you have a stainless steel honeycomb sandwich requirement . . . or other difficult metalworking production problems in the aircraft and missile field . . . consult Rheem. Write to Dept. AW-720-1.



RHEEM HONEYCOMB SANDWICHES
FOR B-58 NACELLES

RHEEM MANUFACTURING COMPANY

Defense and Technical Products Division

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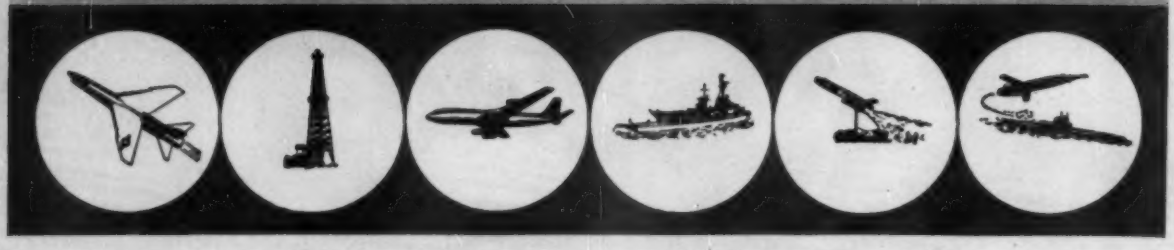

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"GOOD WILL" is the disposition of the pleased customer to return to the place where he has been well treated.
– U.S. Supreme Court

AVIATION CALENDAR

June 16-18—177th National Meeting, American Meteorological Society, San Diego, Calif. To be held in conjunction with the 40th Annual Meeting, American Assn. for the Advancement of Science-Pacific Division.

June 16-July 14—12th Assembly of the International Civil Aviation Organization, San Diego, Calif.

June 22—Symposium on Education in Materials, Chalfonte-Haddon Hall, Atlantic City, N. J. Joint sponsors: American Society for Engineering Education, American Society for Testing Materials.

June 22-26—Summer-Pacific General Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Seattle, Wash.

June 23-25—33rd Meeting, Aviation Distributors and Manufacturers Assn., St. Francis Hotel, San Francisco, Calif.

June 24-26—Second National Symposium, Nuclear Industry Division, Instrument Society of America, Idaho Falls, Idaho.

June 29-July 1—Third National Convention on Military Electronics, Sheraton-Park Hotel, Washington, D. C. Sponsor: Institute of Radio Engineers' Professional Group on Military Electronics.

July 16-17—Third biennial joint meeting, Radio Technical Commission for Aeronautics and Los Angeles Section of the Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

July 28-29—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Westward Hotel, Anchorage, Alaska.

July 30-31—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Fairbanks, Alaska.

July 30-31—Sixth Annual Symposium on Computers and Data Processing, Denver Research Institute, Stanley Hotel, Estes Park, Colo.

(*Continued on page 6*)

AVIATION WEEK Including Space Technology

June 15, 1959

Vol. 70, No. 24

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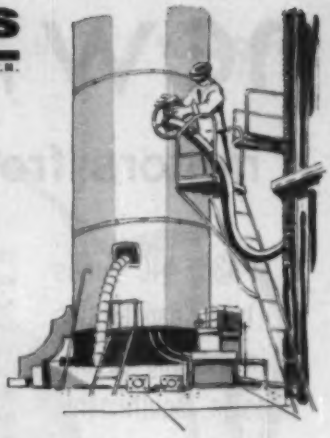
for liquid oxygen and rocket fuels



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Quartector systems and instruments are designed for *bulk liquid applications* such as fuel tanks in missiles or other types of pressure vessels, and for *pumping applications*. A real-time indication is provided when the liquid has reached pre-selected points in pipe lines or tanks.

The Quartector sensing element is a piezo-electric quartz crystal mounted in a probe or submersible sensor unit. Circuitry consists of a four stage transistor amplifier with a transistor detector circuit in the feedback loop, and an output control relay. When the crystal is in gas, it is free to vibrate at its natural frequency, and oscillation is sustained. When the crystal is submersed in liquid, however, its motion is damped, signal output drops, and the output control relay is de-energized.

Splashing, bubbles, and wetting do not affect the sensor. Liquid indication is given only when the crystal is completely surrounded by liquid. Safety features include a fail-safe and function test procedure. Write to Trans-Sonics, Inc., Dept. 7, Burlington, Massachusetts, for Technical Bulletin 1900.

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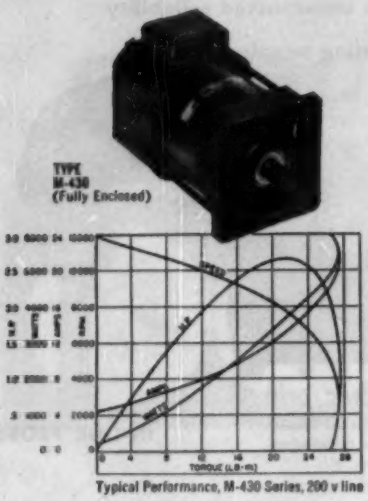
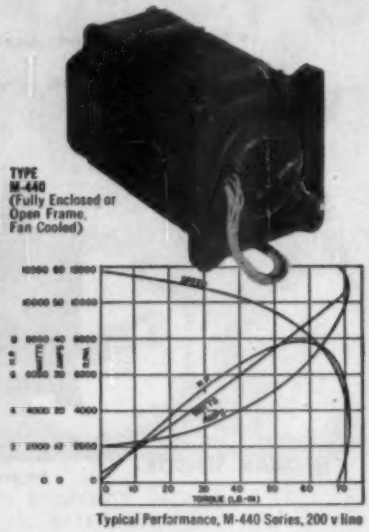
M-430, 440 Series typify capabilities in meeting special design requirements

These 400-cycle, 3-phase, 115/200 v a-c motors were developed originally as components of Airborne large special actuators for aircraft/missile applications. Because of their useful performance characteristics, we now offer them separately—both as additions to our line of special motors and as examples of Airborne capabilities in their particular class of application.



Typical Performance, M-430 Series, 200 v line



Typical Performance, M-440 Series, 200 v line

M-430 Series, 3-in. frame

Intermittent duty ratings to 1.8 hp; continuous ratings to 1.0 hp. Available with magnetic brake which will stop motors in 22 rev. from no-load speed and provide 30 in.-lb. holding torque. Model shown is a 7.5 lb. brake-equipped motor rated 1.5 hp at 10,000 rpm under a duty cycle of 0.5 min. on, 9 min. off.

M-440 Series, 4-in. frame

Intermittent duty ratings to 5 hp; continuous ratings to 2.5 hp (neither of these are absolute ceilings). Optional brake provides holding torque of 140 in.-lb., stops motors in 20-40 rev. from no-load speed. Model shown weighs 13.2 lb. with brake, is rated 4.0 hp at 10,000 rpm—1 min. on, 1 min. off.

Whatever your requirements in large special high-performance motors—a-c or d-c—it will pay you to check with Airborne. Most likely we can furnish a motor of minimum weight and bulk that will meet exactly your specifications. Write or phone any of our offices.

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AVIATION CALENDAR

(*Continued from page 5*)

Aug. 4-5—Second Annual Western Regional Meeting, American Astronautical Society, Ambassador Hotel, Los Angeles, Calif.

Aug. 5-7—William Frederick Durand Centennial Conference on the problems of hypersonic and space flight, Stanford University, Stanford, Calif.

Aug. 17—First National Ultrasonics Symposium, Institute of Radio Engineers' Professional Group on Ultrasonics Engineering, Stanford University, Stanford, Calif.

Aug. 18-21—Western Electronic Show & Convention, Institute of Radio Engineers, Cow Palace, San Francisco, Calif.

Aug. 24-26—Gas Dynamics Symposium, American Rocket Society, Northwestern University, Evanston, Ill.

Aug. 24-26—Institute of the Aeronautical Sciences' National Specialists Meeting, a symposium on anti-submarine warfare, (classified), San Diego, Calif.

Aug. 27-28—International Commonwealth Spaceflight Symposium, Church House, Westminster, London, England.

Aug. 31-Sept. 5—10th Annual Congress, International Astronautical Federation, Church House, Westminster, London.

Sept. 1-2—Conference on physical chemistry in aerodynamic and space flight, University of Pennsylvania, Philadelphia, Pa. Sponsors: Air Force Office of Scientific Research and General Electric Co.'s Missile and Space Vehicle Dept.

Sept. 2-4—1959 Cryogenic Engineering Conference, University of California, Berkeley, Calif.

Sept. 3-6—National Convention and Aerospace Panorama, Air Force Assn., Exhibition Hall, Miami Beach, Fla.

Sept. 7-13—1959 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 9-11—Sixth Midwestern Conference on Fluid and Solid Mechanics, University of Texas, Austin, Tex. Sponsors: AFOSR/Directorate of Aeronautical Sciences; Office of Naval Research; National Science Foundation.

Sept. 16-17—Western Regional Meeting on Frontiers of Science and Engineering, Institute of the Aeronautical Sciences, Los Angeles, Calif.

Sept. 23-24—Engine and Operations Symposium, Airwork Corp., Millville, N. J.

Sept. 24-25—Solid Propellants Conference, American Rocket Society, Princeton University, Princeton, N. J.

Sept. 28-30—1959 National Symposium on Telemetering, Civic Auditorium and Whitcomb Hotel, San Francisco, Calif. Sponsor: Institute of Radio Engineers' Professional Group on Space Electronics & Telemetry.

Oct. 5-7—Seventh Anglo-American Aeronautical Conference, Institute of the Aeronautical Sciences, Hotel Astor, New York.

Oct. 5-10—National Aeronautic Meeting, Society of Automotive Engineers, the Ambassador, Los Angeles, Calif.

Oct. 6-8—12th Annual Meeting, National Business Aircraft Assn., Hotel Leamington, Minneapolis, Minn.

Oct. 12-16—15th General Convention of the International Air Transport Assn., Tokyo, Japan.

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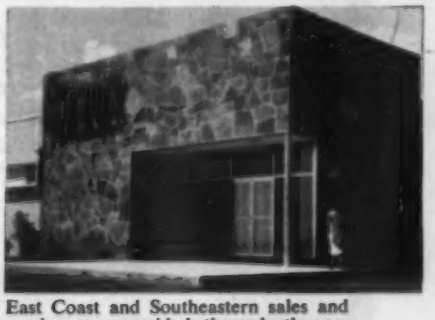
If you would like a complete brochure of Holley products, facilities, and service outlets, simply address the Aircraft Division at Holley.

West Coast and other Western states airlines and commercial customers are serviced through the several branches of the Pacific Airmotive Corporation and its subsidiaries

The handsome new facilities of the Southwest Airmotive Corporation at Love Field, Dallas, Texas, are headquarters for Holley sales and service for Dallas and other south Texas areas.



East Coast and Southeastern sales and service are provided through the organization of the Airwork Corporation and its several branch locations.

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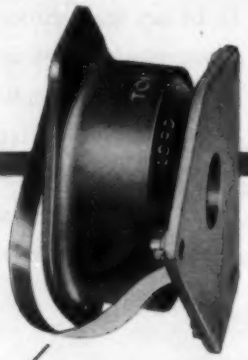
vital electronic equipment is *"soft mounted"* on F-105

Critical electronic units on the Air Force's Mach 2 F-105 Thunderchief fighter-bomber are "soft mounted" on LORD vibration control systems. Operational reliability is thus assured for a toss bomb computer, sight amplifier and two integrated electronics chassis.

Use of resilient suspension systems—custom designed—provides positive protection against the extreme disturbances of the advanced jet environment. By working with LORD, F-105 contractors obtained the lightest, most economical suspensions in the shortest time

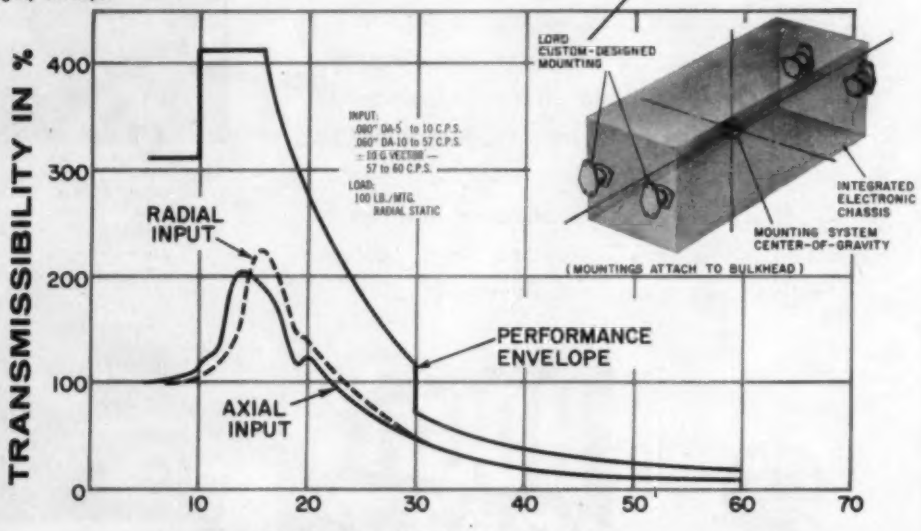
If you have a problem in the protection of sensitive equipment, LORD offers you a broad background of vibration/shock/noise control experience in air, space, marine and ground environments. Your inquiry will be welcomed. Contact your nearest LORD Field Office or the Home Office, Erie, Pa.



Vibration/shock/noise control—Two integrated electronics chassis on Republic F-105 jet fighter are mounted on special Lord high-performance isolators. Severe environment includes vibration, superimposed sustained accelerations to 9 G and 30 G shock loads throughout temperature range from — 65° to + 200° F.

In final design shown, four isolators weighing less than 1.5 pounds each support chassis weighing between 266 and 400 pounds. Use of Lord BTR (Broad Temperature Range) elastomer assures excellent damping plus constant performance over wide temperature range.

Transmissibility curve shows how efficient vibration isolation keeps equipment well inside fragility envelope.



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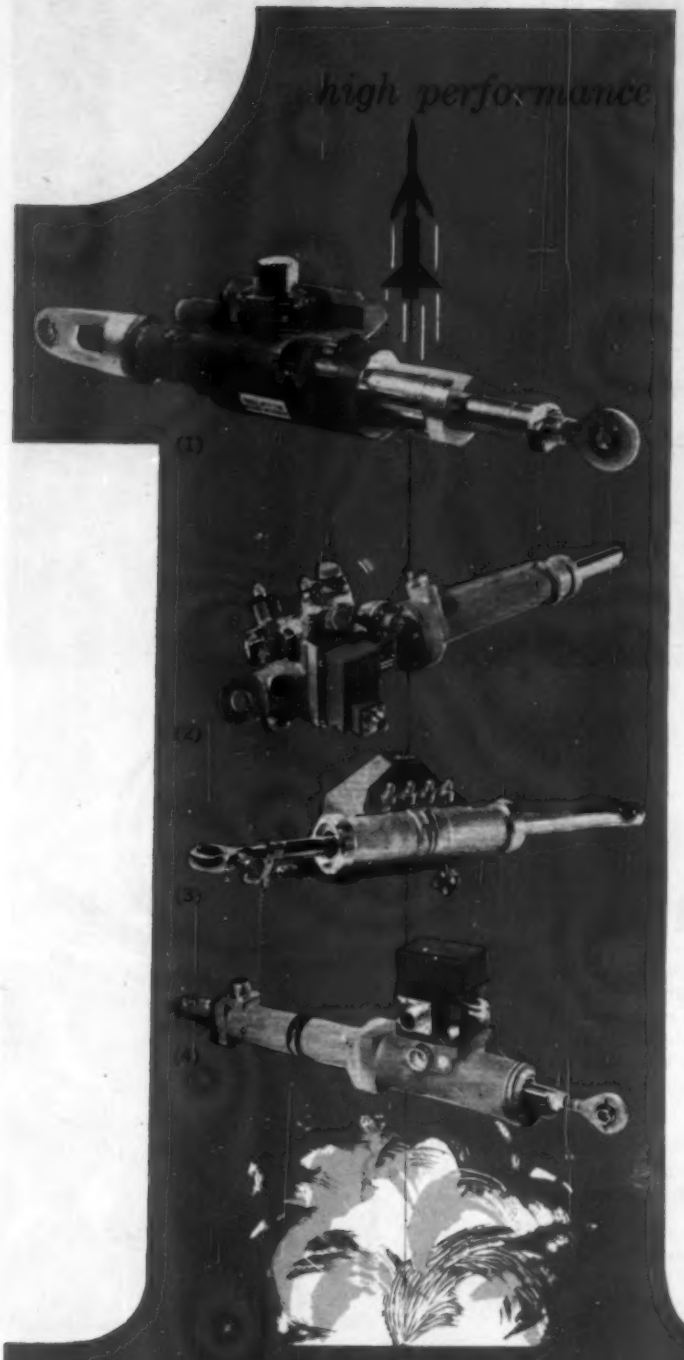

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HYDRAULIC RESEARCH designs and builds complete packages for engine, flight and other precision control. Servo, actuator, filters, transducers, valves, potentiometers – all are integrated into one single unit that simplifies test and check. Hydraulic Research control packages are in use, now, on leading aircraft, missile and space craft.

Typical:

(1) **On ICBM.** Controls rocket engine position. **First fully qualified control actuator.** Features extreme environment servo valve.

(2) **On IRBM.** For engine positioning. Features mechanical position feedback.

(3) **On newest interceptor.** Actuates control surfaces. Features dual hydraulic systems. Responds to manual or electrical commands.

(4) **On satellite** (final stage). Engine position control. Features cylinder snubbers, and load limiters.

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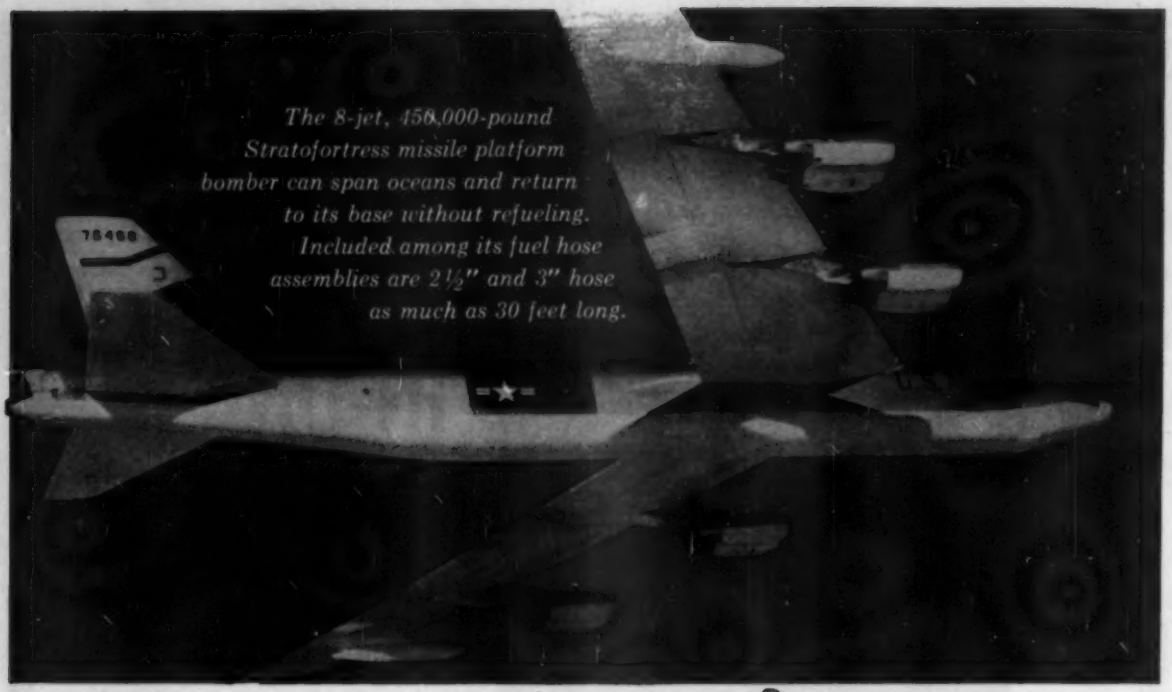
HYDRAULIC & PNEUMATIC VALVES

PRESSURE SWITCHES



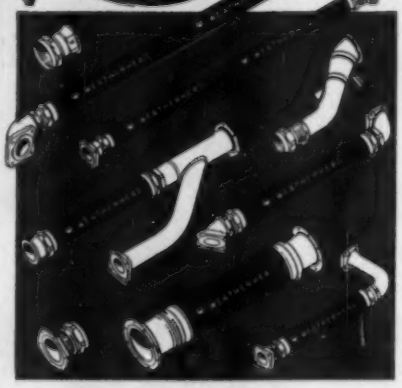
The 8-jet, 458,000-pound Stratofortress missile platform bomber can span oceans and return to its base without refueling. Included among its fuel hose assemblies are 2½" and 3" hose as much as 30 feet long.

75 Fuel Line Assemblies on B-52G . . .

Completely New . . .

Developed and Produced by

WEATHERHEAD



The Weatherhead fuel line system for Boeing's B-52G meets heretofore unknown requirements in terms of operating characteristics, material properties, light weight and unusually large range of sizes (1½" to 4" I.D.) Approximately 75 different assemblies provide continuous distribution of fuel in the integral wing and fuselage tanks to the eight jet engines. The special hose is impervious to the JP-4 or JP-5 fuels employed, even where it remains immersed in fuel.

In developing the entirely new hose assemblies, Weatherhead worked on the specifications with Boeing engineers. Shortly afterward, Weatherhead had established mass production of the full range of qualified assemblies.

This is an example of how Weatherhead smoothly synchronizes its vast research and development, engineering and manufacturing facilities to originate and supply special needs within tight timetables. Whatever your fluid system requirements, look to Weatherhead for assistance from concept through production.

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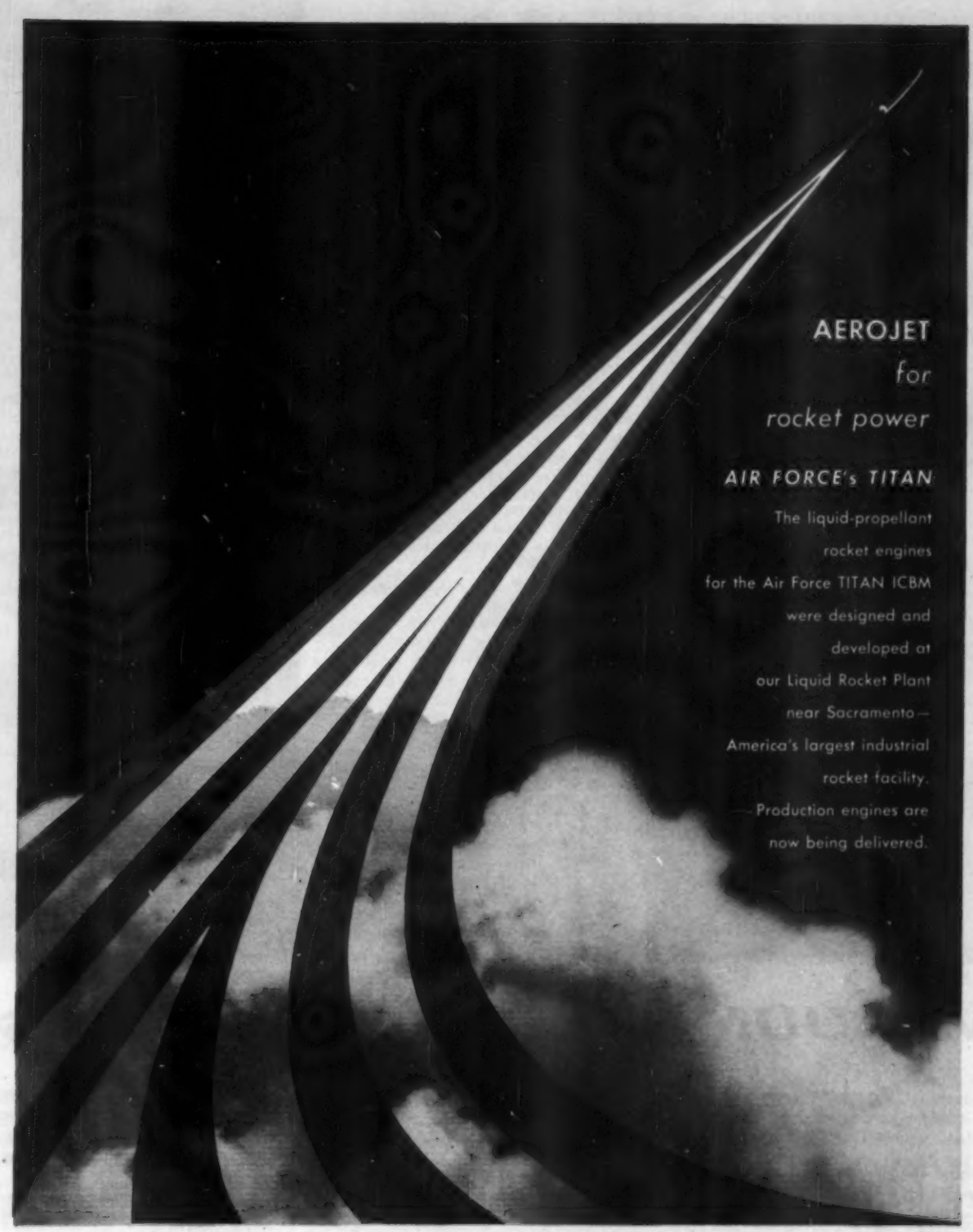

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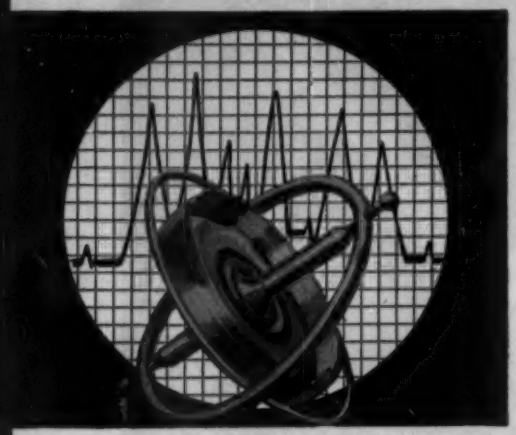
THE GENERAL TIRE

A SUBSIDIARY OF THE GENERAL TIRE & RUBBER COMPANY

Engineers, scientists—investigate outstanding opportunities at Aerojet. (Plants at Azusa and near Sacramento, Calif.)



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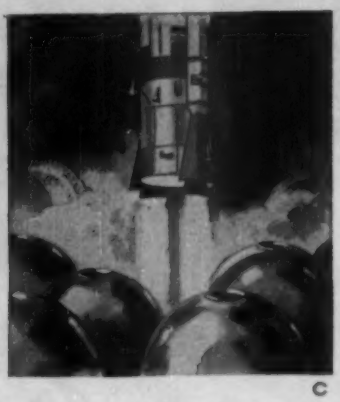

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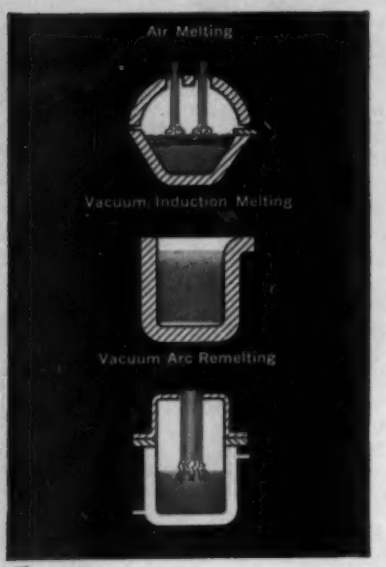

d

a. Titanium slabs are heated prior to rolling into continuous sheet coils. Crucible's increased capacity for producing high purity metals, in all sizes and mill forms, is substantially reducing costs and delivery times.

b. Vacuum Melted Alloys are specified for gyroscope balls used in navigational and fire direction systems. The metals' improved properties facilitate miniaturization.

c. Titanium helium storage bottles for ICBM Atlas. Titanium, which must be vacuum melted, was selected because of its high strength weight ratio, cold-resistant properties and corrosion resistance.

d. Basic Melting Processes. Vacuum induction melting produces "purer" metals than conventional air melting because it eliminates all sources of contamination except the crucible. Vacuum arc remelting eliminates the crucible and permits production of ingots up to 18,000 lbs.

VACUUM MELTING CREATES

Marked improvements in properties produced by High-Purity Metallurgy

Behind the development of space-age metals with entirely new characteristics is vacuum melting — a series of processes that produce "purer" metals with better properties.

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SUPER-DUTY METALS

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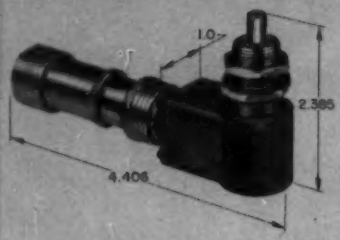

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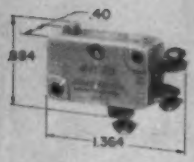

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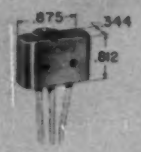

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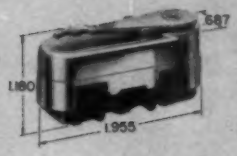

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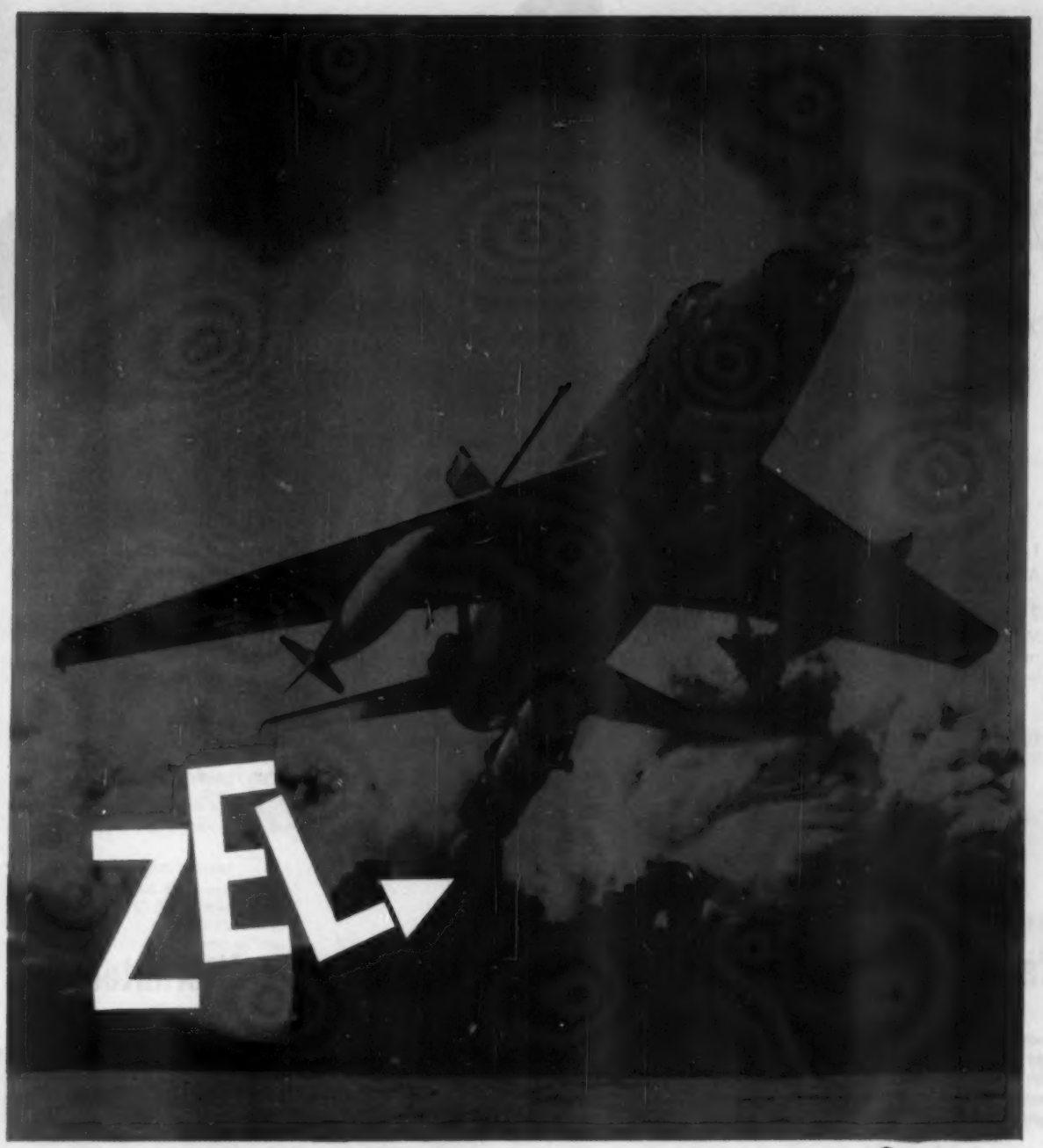

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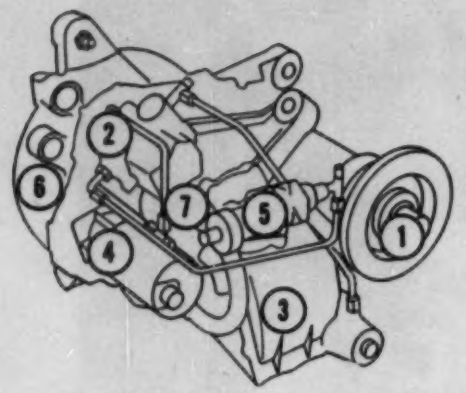

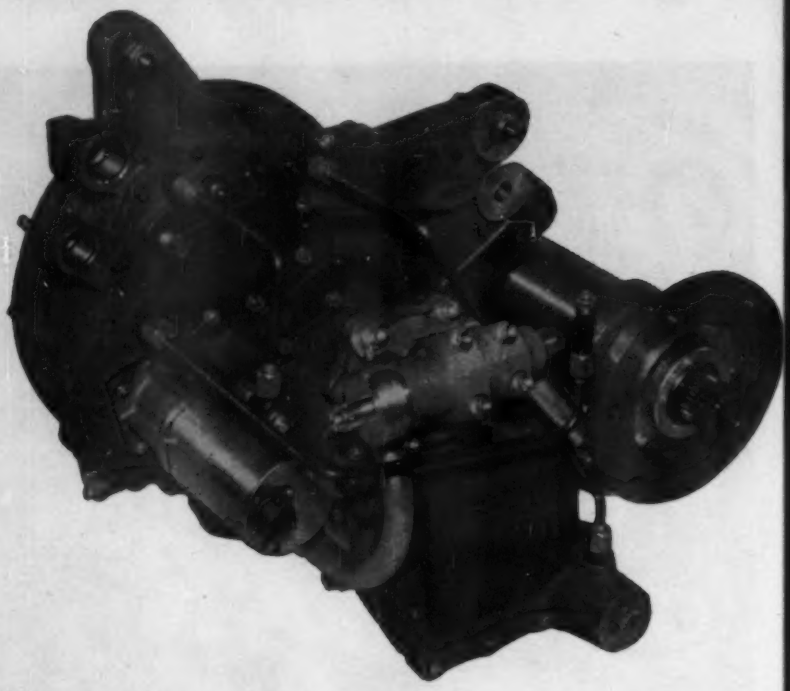

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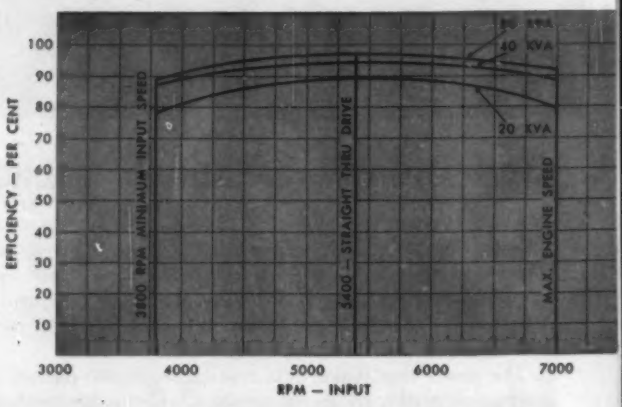

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COVER: First Boeing IM-99B Bomarc interceptor missile is launched at Air Force Missile Test Center's Cape Canaveral, Fla., complex. External configuration of Bomarc B is almost identical to the IM-99A Bomarc. The B model has a Thiokol solid propellant booster and two Marquardt RJ43-MA-7 ramjets; its range is about 450 naut. mi. The A model has an Aerojet-General LR59-AG-13 liquid propellant booster and two Marquardt RJ43-MA-3 ramjets which develop about 10,000 lb. thrust in cruise phase; range is about 250 naut. mi. For other Bomarc B photos, see pp. 30-31.

PICTURE CREDITS

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Improved submarine detection equipment and an advanced navigation system developed jointly by the Navy and Sikorsky, combined with anti-icing equipment for the rotor assembly and automatic stabilization equipment, make the HSS-2 an integrated weapon system capable of around-the-clock all-weather operation.

Now in production, the HSS-2 is Sikorsky's second boat-hulled turbocopter. It joins a family of Sikorsky helicopters whose service is unequaled in military and commercial operations throughout the world. SIKORSKY AIRCRAFT, Stratford, Connecticut. A division of United Aircraft Corporation.

EDITORIAL

ANP's Political Pitfalls

(Rep. Melvin Price, chairman of the Research and Development Subcommittee of the Joint Committee on Atomic Energy and a persistent advocate of placing a nuclear-powered aircraft into the air at the earliest possible date, outlined the political pitfalls that have beset the U. S. ANP program during the 12 years of its rocky existence in a speech prepared for delivery last week at a meeting of the Aircraft Luncheon Club in Washington. Rep. Price also expressed the hope that the Administration and the Defense Department may finally be on the verge of drafting a firm program for the development of a nuclear aircraft. AVIATION WEEK *is reproducing below major portions of the speech because of its interest and significance to industry.)*

. . . The nuclear-powered plane, despite its advanced technical status, has been with us for over a dozen years now and has been the object of intense interest and support by the Joint Committee on Atomic Energy of the Congress. . . .

By 1953, the direct cycle propulsion system had been developed to a point where the Air Force proposed to try it out in a flying testbed, utilizing a modification of the B-36 bomber. The technical people in the field now feel that if this program had gone forward vigorously, the chances are good that we would have had such a flying testbed in 1957.

You may remember this B-36 flying testbed concept was effectively spiked by Secretary Wilson in 1953 in his famous "Shitepoke" statement, and the whole ANP program was virtually canceled. Only the most strenuous efforts on the part of the program's advocates and the Joint Committee kept the project alive, albeit on a clearly reduced basis.

Then in 1955 the Air Force built up another head of steam for a high performance nuclear bomber, including a complete weapons system, basing its proposals on promising technical developments to that point. This was approved and the large scale project was begun, only to fall of its own weight in 1957. The disapproval of this concept in 1957 by the Defense Department had unfortunate ramifications far transcending the mere cancellation of the high performance idea.

The effect of this action, which we can still feel today, was to place the whole concept of effective nuclear flight in doubt in the minds of many people, and this period of disenchantment reversed the impetus in Washington toward pressing ahead to a successful resolution of the technical problems involved. . . .

In the fall of 1957, a more realistic proposal was brought forward in the Pentagon to proceed with a flying testbed utilizing a modified conventional plane as the carrier of the nuclear propulsion system. This proposal, which was based on sound technical considerations, was on its way to approval by the Secretary of Defense until the intervention of two new and important factors.

One of these was the emergence of a special panel set up by the President's Scientific Advisor, Dr. (James R.) Killian, who raised serious questions about the readiness of the project technically to go forward to a prototype flight program. It is interesting to note that this "expediting" group, whose review of the project was cursory in nature, intervened with the Defense Department in an "advisory" capacity before the Defense Department itself had made its recommendation to the President.

The second factor which emerged at this time was a sudden renewal of interest in the ANP program by the Navy, who took sharp issue within the Defense Department on the dominant role which had been assumed by the Air Force in the program. While I am all for active Navy participation in the program, together with the Air Force, this particular action by the Navy created confusion within the Defense Department as to appropriate assignment of responsibilities. Before the smoke had cleared, the Killian Committee had gone to work and the flying testbed concept once again bit the dust. . . .

In an attempt to meet this question of usefulness which had been raised by the President, the Air Force last year established a requirement for the so-called CAMAL system, which called for the construction of a new prototype aircraft capable of serving as an initial test vehicle and later, with any necessary modifications in the design, as an operational military aircraft. While no approval of this requirement has yet been made by the Defense Department, plans are proceeding and Convair has recently been selected in a competition with Lockheed, to develop designs for the airframe. . . .

I think it must be evident from the brief history I have described to you, that the ANP program has been beset by a multitude of problems since its inception. . . .

. . . Particularly vexing, after twelve long years, is the fact that the program still has no firm target date for the first flight and our scientists and engineers in the field still don't know where they stand as to the future prospects for the program. . . .

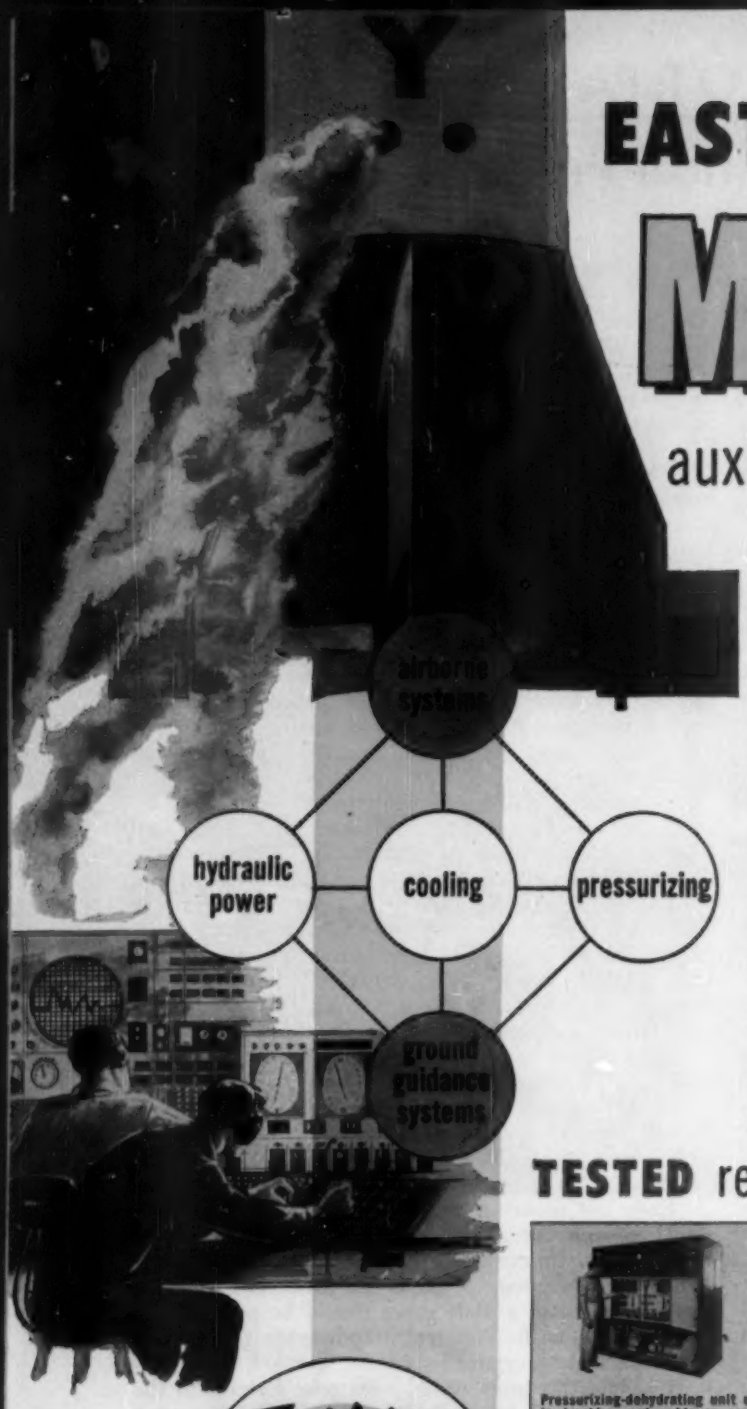
. . . Unless I am sadly mistaken, I think the concept is finally percolating through to those who have responsibility for making this decision on a flight program. I hope so. . . .

Early last month a critical series of discussions was held between representatives of the Defense Department and AEC with regard to possibilities for development of a flight program. I gather the consensus of these sessions was that a draft paper should be prepared for presentation to the President, recommending the initiation of a flight program.

I believe this paper would have gone forward to the President except for the untimely death of Secretary Quarles. . . .

Responsibility for the ANP project has, since Mr. Quarles' departure from the scene, been vested in Dr. Herbert York, Assistant Secretary of Defense for Research and Engineering. Members of the committee got together informally with Dr. York and Mr. (John A.) McCone, chairman of the AEC, a couple of weeks ago to discuss the progress of the program and the question of whether or not plans are being made to go forward with the prototype flight program. At that time, we agreed that the Defense Department and AEC would report to the committee some time this month on what action is to be taken. . . .

EASTERN... pioneer in MISSILE auxiliary power subsystems



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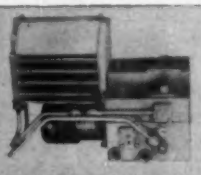
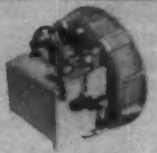
High-speed gear pump provides hydraulic power to missile as integral part of APU system.



Cools high-powered electronic tubes in guidance sections of missiles.

Eastern power-pack gives hydraulic power for missile elevons and wing-folding actuators.



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Gustav Wedell, 1959 board chairman of Scandinavian Airlines System, Inc.

Frederick E. Hines, a director, Electronic Engineering Co. of California, Santa Ana.

Oliver J. Greenway, president, and **Guy B. Entrekin**, vice president and general manager, Communication Accessories Co., Lee's Summit, Mo., a subsidiary of Collins Radio Co.

E. O. Cocke, senior vice president and system general manager, Trans World Airlines, Inc. Also: **Floyd B. Hall**, vice president and general transportation manager, Transportation Division; **Louis P. Marechal**, vice president and general sales manager, Sales Division. Other new officers of the Transportation Division are: **Robert D. Mueller**, assistant vice president-flight operations, and **J. J. Greenwald**, assistant vice president-passenger service.

Richard W. Cook, deputy group executive and divisional vice president, American Machine & Foundry Co.'s Government Products Group, Washington, D. C.

B. J. Driscoll, vice president-general manager, General Applied Science Laboratories, Inc., Hempstead, N. Y.

Dr. Herbert Trotter, Jr., senior vice president-engineering and research, Sylvania Electric Products, Inc., subsidiary of General Telephone & Electronics Corp., New York, N. Y.

Robert D. Richmond, a vice president, Canadair, Ltd., Montreal, Canada, subsidiary of General Dynamics Corp. Mr. Richmond will take charge of Canadair's newly organized Missiles and Systems Div.

John B. Darrah, vice president and general manager, the Budd Co.'s Defense Division, Philadelphia, Pa.

Maj. Gen. Dudley Durward Hale (USAF, ret.), assistant to the president, Cook Electric Co., Chicago, Ill.

Maj. Gen. Joseph D. Caldara, Air Force Director of Flight Safety Research, has been appointed to the newly organized Office of Deputy Inspector General-Safety, Washington, D. C.

George F. Hannaum, vice president, and **Samuel L. Wright**, assistant secretary, Aerospace Industries Assn., Washington, D. C. Mr. Hannaum continues as assistant general manager of AIA, and Mr. Wright as executive assistant to the president.

Jacob M. Roey has been named National Aeronautics and Space Administration's Small Business Adviser.

Honors and Elections

Maj. Gen. Otis O. Benson, Jr., Commandant of the Air Force School of Aviation Medicine at Randolph AFB, has been named president of the Pan American Medical Assn.'s Section on Space Medicine.

Dr. Arvin J. Klein, a Medical Corps captain serving as a flight surgeon at the 4030th U. S. Air Force Hospital, Bergstrom AFB, has been selected as the recipient of the second ALPA Fellowship in Civil Aviation Medicine at the Ohio State University School of Graduate Medicine.

(Continued on page 110)

INDUSTRY OBSERVER

► National Aeronautics and Space Administration is investigating methods of detecting the re-entry of ballistic missile nose cones by picking up with radar the ionized particles, or "ion sheet," the cone gives off as it strikes the molecules of the atmosphere. For the tests, NASA has developed a four-stage research missile which fires a recovery package to an altitude of approximately 200 mi. At peak altitude and after separation of the final stage, three small rocket motors in the package fire in quick succession, driving the package back toward earth at speeds of approximately 16,000 mph. An initial vehicle in the program already has been launched. Massachusetts Institute of Technology's Lincoln Laboratories is cooperating in the project and providing the radars used in attempts to detect the "ion sheet" given off by the velocity package.

► Thompson Ramo Wooldridge officials are continuing search for a suitable buyer for Space Technology Laboratories. Negotiations with several educational institutions reportedly have fallen through over question of price.

► First XLR99-RM-1 liquid propellant rocket engine for North American's X-15 research aircraft is on its way to Edwards AFB, Calif., from Reaction Motors Division of Thiokol Chemical Corp. First engine is a non-flying powerplant and will be used in ground tests and run-ups to provide experience in fueling, handling and other procedures. Contract also calls for a second non-flying engine which is now undergoing qualification testing and static firing on the Reaction Motors test stand in Denville, N. J. First flight version of the XLR99-RM-1 will be delivered as scheduled in July (AW Mar. 30, p. 59). Actual flight testing of the X-15 with the new engine is still expected to take place some time this fall. Initial power for the X-15 pending installation of a single XLRO-RM-1 is being supplied by two Reaction Motors XLR11-5 engines.

► Cancellation of the Fairchild J83 engine program has forced a reorientation of the development of Northrop Aircraft's Q-4 target drone. The drone, now designated the Q-4B, will be retrofitted for the General Electric J85, with operational deliveries to the Air Force scheduled to begin in 1961.

► To provide a more equal—and favorable—basis for comparison with solid propellants, liquid propellant rocket manufacturers have generally agreed on 1,000 psia. combustion chamber pressure as the primary standard for reporting liquid propellant performance. This is the same pressure that is being used in the calculation of solid propellant performance and gives a higher reading than the 300 psia., 500 psia. and 600 psia. combustion chamber pressures commonly used in the past for figuring liquid propellant performance.

► Westinghouse Air Arm Division has been formally notified by North American Aviation that it has been selected to develop and produce electronic countermeasures system for the B-70. North American originally picked Westinghouse over a team headed by General Electric and Radio Corporation of America but its choice was questioned by Wright Air Development Center (AW May 18, p. 23).

► Thirty-fifth Convair B-58 Mach 2 bomber is now well along the final assembly line at the Ft. Worth Division. Current Air Force contracts for the B-58 cover 106 aircraft.

► Operations and maintenance of the power facilities for the SAGE-Boeing Bomarc bases in Air Force's Northeast Air Defense District will be conducted by Vitro Engineering Co. under a $2.2 million USAF contract. Facilities will be located at McGuire AFB, N. J.; Stewart AFB, N. Y.; Syracuse AFB, N. Y.; Topsham AFB, Me., and Fort Lee, Va.

► Federal Aviation Agency has asked Defense Department and the airlines to relinquish total of five megacycles of radio spectrum by July, 1960, for use in expanding traffic control facilities. Airlines appear willing to give up two megacycles requested of them, but Defense Department is opposed to giving up 132 to 135 mc. band now planned for use with Nike Zeus ICBM defense missile. The President is expected to override Defense Department objection.

••••• MISSILE GUIDANCE OUTPOST •••••••

The Radar Course-Directing Centrals designed and produced by Stavid for the REGULUS missile provide the Navy a means of pin-pointing tremendous striking power against targets in hostile territory. Submarines now operational are capable of command-guiding the missile in flight, and provide missile crews with an automatic presentation of bearing and range information through data-stabilization and course computers.

Stavid's electronics capability is strikingly demonstrated in this task which required design and manufacturing skills ranging from the antenna to the computers – all developed and produced within our facilities.

The Stavid capability ranges from original research to system redesign for mechanized production. Recent accomplishments include:

- Gun Fire Control System Mark 70
- Radar Beacon for X-15 Aircraft
- Beacon Telemetering System

Stavid Section Engineer, Richard Holmberg, has 12 years' experience in electronics development, including project direction of guidance systems, electronic simulators and fire controls.

STAVID Engineering, Inc. Plainfield, New Jersey

Imaginative Electronics...

Outstanding engineers and scientists are invited to inquire into opportunities on Stavid's advanced systems engineering teams.

Washington Roundup

Unicom Decision

Watch for an Army decision on a contractor to head its new Unicom global communication system improvement/development program within the near future, sometime probably in July. Five teams of companies have submitted bids. The program is in some ways comparable to Air Force's recently launched 480-L communication system research and development project awarded to International Telephone & Telegraph Corp.

'Master' Air Defense Plan

A "master plan" for U. S. air defense reportedly sticking with the Defense Department and Administration decision to produce both the Air Force-Boeing Bomarc interceptor missile and the Army Nike Hercules point defense system despite demands in some congressional quarters that one or the other be eliminated was scheduled to be presented to Congress in executive session late last week by Defense Secretary Neil McElroy.

The plan may, however, call for fewer missiles in both categories than that originally requested in the Administration's Fiscal 1960 budget and may approve a cutback in North American F-108 Mach 3 interceptor program.

A revised program for, or at least a new look at, air defense was urged by Congress earlier this year after claims and counterclaims regarding the relative merits of the area-defense Bomarc vs. the point-defense Nike Hercules were publicly debated. The House Defense Appropriations Subcommittee, after listening to the conflicting claims of Air Force and Army officials during Fiscal 1960 budget hearings, called for an immediate re-examination of the entire program at the highest level.

Symington: More SAC Funds

Meanwhile, Sen. Stuart Symington (D.-Mo.), a member of the Senate Defense Appropriations Subcommittee, last week reiterated his criticism that the U. S. is spending "billions" for obsolete air defense systems which "could not prevent heavy losses" in the event of an attack, when the nation should be modernizing the Strategic Air Command, its major war deterrent power. Under the present program, he said, only 5% of the Air Force's B-47 bombers are scheduled to be replaced by the Convair B-58 Mach 2 bomber over a three year period.

NASA Budget Approval

Authorization for the National Aeronautics and Space Administration's full Fiscal 1960 budget request of $485,300,000 cleared Congress last week when the House accepted Senate amendments without sending the bill to conference. The measure authorizes appropriations of $94.4 million for salaries and expenses, $333 million for research and development and $57.8 million for construction and equipment for Fiscal 1960.

Senate amendments accepted by the House are:

- **Restoration of $4.7 million** for construction of a new central facility for high-energy solid and liquid fuel rocket propellants deleted by the House.
- **Restricted House provision** that would permit use of research and development funds for capital items by requiring NASA to first notify both the House and Senate space committees of the nature, location and estimated cost of the facility.
- **Deleted terminal date** of July 30, 1965, on a provision which requires prior congressional authorization of NASA appropriations, thereby making the requirement one of indefinite duration.

Contractor Security

NASA reported last week that it also has completed an agreement for the Defense Department to act on its behalf in security matters relating to contractors. Under terms of the agreement, the Defense Department will issue security clearances to employes of NASA contractors and inspect contractor facilities and operations. The arrangement applies to both contracts administered by one of the military departments for NASA and those administered solely by NASA. The Defense Department, by making its Industrial Security Program available to NASA, has eliminated the need for the agency to establish a similar program of its own.

Air Transport Panel

Civil Aeronautics Board officials, airline attorneys and airline representatives are scheduled to participate in a panel discussion on legislative or administrative problems affecting the industry today at a hearing of the House Subcommittee on Legislative Oversight. Topics for discussion include:

- **Legislative or administrative** measures which have been or should be taken to preclude any attempts to influence Board members or employes.
- **Role of hearing examiners** and what legislative measures should be taken to increase their stature and effectiveness.
- **Role of commissioners,** immediate staffs and agency staffs, division of responsibilities and the present strength and weaknesses of the organizational system.
- **Efficiency of the Board** and changes necessary in existing statutory provisions to enable its commissioners to cope with the increasingly enormous volume of business coming before them.

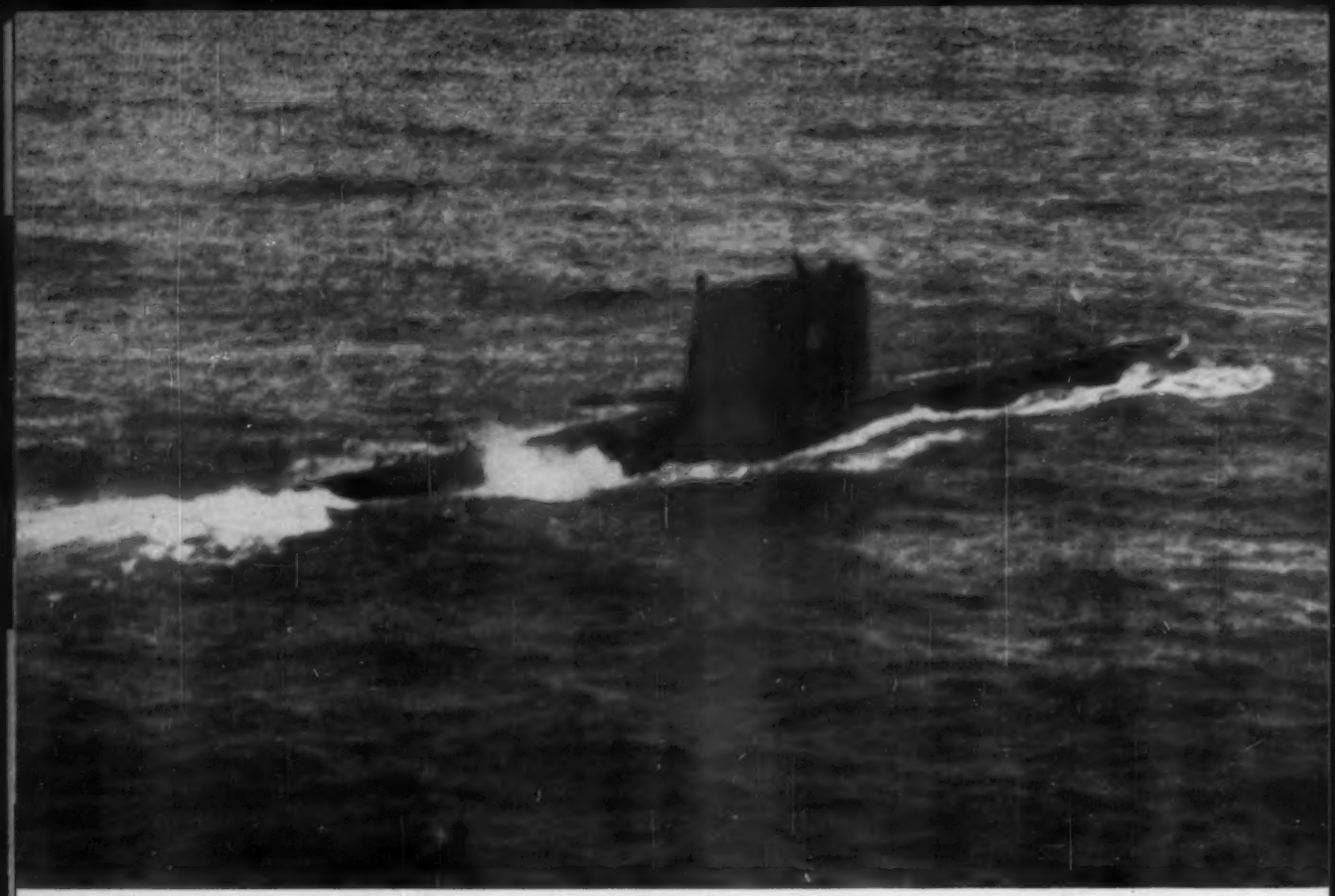
AAXICO Request

AAXICO all-cargo domestic carrier, which asked the Civil Aeronautics Board for subsidy relief more than a year ago (AW April 28, 1958, p. 40), is now concentrating on military contracts and has asked the Board for permission to suspend its scheduled cargo operations by June 30. The carrier has been named low bidder on four out of seven Logair (Air Force) contracts which, it believes, should earn more than $12 million.

Mobile Lounge Contract

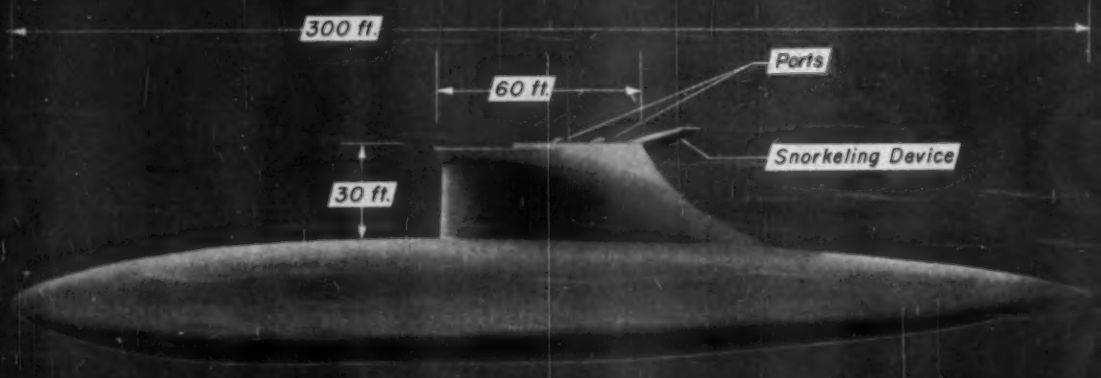
Federal Aviation Agency has announced the letting of proposals for design, construction and testing of a prototype mobile lounge to be used for terminal-to-aircraft passenger transportation at Washington International Airport, Chantilly, Va. (AW April 13, p. 41). The agency has set a time schedule calling for completion of the prototype structural, mechanical and engineering features by Feb. 1, 1960, and a completed prototype plus production plans and specifications by May 1, 1960. In-service testing of the prototype will be conducted by the contractor at an airport selected by FAA before the vehicle is turned over to the agency for final acceptance.

—Washington staff



Soviet Missile Launching Submarines Sighted

Two types of Soviet missile submarines have been sighted on operational patrols in the Atlantic. Aviation Week artist's conception (below) has been identified as a long-range, conventional-powered ballistic missile submarine, probably a modified "Z" class, which reportedly is in large-scale production. Its solid propellant missiles are stored vertically in the 30-ft.-high conning tower. Missile exit ports (see sketch) are four feet in diameter. Both may be launching tubes or one may be used to bleed off exhaust gas at launch. It is not known whether launches can be made from below the surface. It is known, however, that it can cruise from its home port to a position near Rio de Janeiro, stay on station for 20 days and then return —all without positive evidence of any refueling while en route home. Picture of the Soviet submarine (above), also a modified version of the "Z" class with an enlarged conning tower, was taken recently by a Navy patrol plane south of Iceland. The submarine's store of missiles, which are also probably ballistic, may be located in the conning tower.



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Air Force Tightens Contract Procedures

Additional auditors employed; plan to notarize cost statements approved in wake of GAO report.

By Katherine Johnsen

Washington—Air Force last week took steps to tighten its control over contract pricing, responding quickly to the congressional clamor touched off by a General Accounting Office report which showed excessive pricing of $30 million in 14 contract cases with industry (AW June 8, p. 26).

GAO declared that the over-pricing was due to the fact that prime contractors knowingly misquoted subcontract costs or entered into fixed-price, rather than redeterminable, contracts on new types of equipment on which there are no cost guidelines or that USAF had been negligent in catching unintentional errors in contracts.

Philip B. Taylor, Assistant Air Force Secretary for Materiel, who said USAF considered the GAO report "fair and constructive," told the House Armed Services Investigating Subcommittee that:

• **Funds have been transferred** from other accounts so that 203 additional auditors can be hired to police procurement contracts. At present, the Air Force has approximately 1,000 auditors in its employ.

• **USAF agrees to a proposal** to require contractors to have their cost statements notarized, so that, as in the case of income tax returns, they could be subject to prosecution for any wilfull misstatement. Subcommittee members complained that Air Force's original plan for certificates of correctness from contractors had no "bite."

• **USAF has already** obtained reductions from most of the contractors in the cases of over-pricing due to excessive estimates. These cases totaled $17 million out of the $30 million.

Major Cases

Details on the three major cases involving a total of $15 million, as outlined to the House Subcommittee, include:

• **Boeing Airplane Co.** GAO claimed subcontract costs used by the company on two B-52 contracts totaling $72 million were excessive by $5 million. Boeing has agreed to a $4.1 million reduction. Air Force said it is still "not satisfied." Later, William M. Allen, Boeing president, issued a statement saying that: "The GAO has not accused the Boeing company of bad faith in these matters. Like several other companies, Boeing has submitted adjustments . . . Too often, criticism of individual transactions such as these creates an impression of unwarranted profits, whereas in fact other estimate developments cause profit reductions. The important figures are those relating to the complete programs. Boeing stockholders are familiar with these total results, reflected in the company's modest earnings . . ."

• **Lockheed Aircraft Corp.** GAO said subcontract costs for airframe components for C-130A transports were overpriced by $4.1 million. Lockheed has agreed to a price reduction of $4.9 million, substantially more than the GAO claim.

• **McDonnell Aircraft Corp.** GAO charged that estimates used by the company in negotiating a target price of $102 million for USAF F-101A aircraft contained estimated subcontract costs which McDonnell knew were $5.2 million higher than it was going to pay. Unable to reach agreement with the company, the Air Force has turned the case over to Justice Department.

Meanwhile, there are these major developments to watch for:

• **House Armed Services Investigating** Subcommittee headed by Rep. Edward Hebert (D.-La.) will begin public hearings early next month on the hiring of former military officers and civilian officials of Department of Defense by companies doing business with the services.

• **General Accounting Office** will submit a report covering overpricing on Navy aircraft and electronics contracts to Congress early in July.

• **Senate Armed Services Subcommittee** headed by Sen. Strom Thurmond (D-S. C.), is tentatively scheduled to begin hearings on military procurement legislation on June 22.

Hebert Probe

Rep. Carl Vinson (D.-Ga.), chairman of the House Armed Services Committee, under overwhelming congressional pressure, directed the Hebert subcommittee to move forward with the investigation of former military officers employed in defense industries. An

Japanese Near Fighter Decision

Japanese decision on which U. S. fighter to use for its Self Defense Force—the Grumman F11F-1F or Lockheed F-104C—will be made before the end of this month, capping a controversy between the Japanese Defense Agency and some members of the Japanese Diet.

Japanese Defense Agency still favors the Grumman plane, which was tentatively chosen by the Joint Defense Council on April 12, 1958. Decision, however, was sharply criticized by some members of the Diet who favor the F-104C. Their strongest argument backing the Lockheed plane is the price of $750,000 per plane offered to the Japanese government; price for the Grumman F11F-1F (designated 98J-11 for export) was about $1 million. This price per plane was proposed jointly by Grumman and Mitsubishi Heavy Industries by order of Japanese Defense Agency, after the tentative decision.

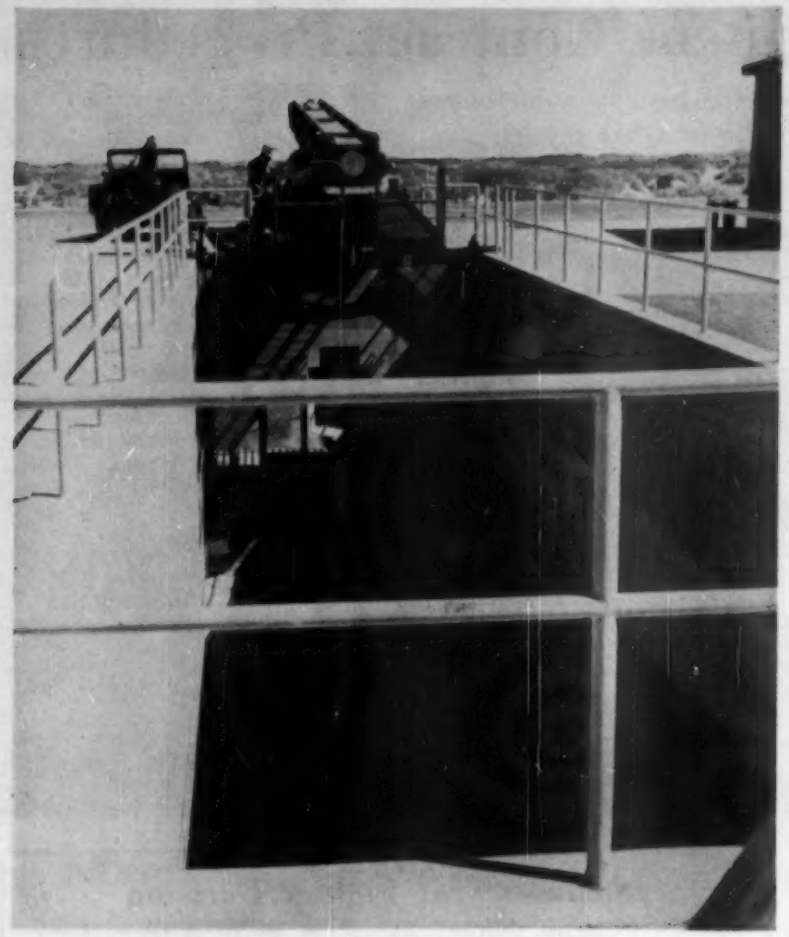
Feeling within Japanese Defease Agency is that the F-104C price would rise to more than $1 million when specifications are complete. It was pointed out that F-104 price to West Germany was about $1,360,000 per plane.

At present, there is a movement in the Japanese Defense Agency to compromise in the selection conflict, and buy both airplanes. Originally, the Agency wanted 300 Grumman 98J-11s but that was downgraded to about 200. If both aircraft were ordered, the quantity again would be changed, but feeling is that not more than two squadrons of F-104Cs would be involved. Engines for both would be General Electric J79-7 turbojets.

Sources indicated that if both fighters are chosen, the F-104C will be built by Lockheed at Burbank, Calif., and the F11F-1F will be built in Japan by Mitsubishi.

Armament for these aircraft would be Sidewinder SW-1A (advanced version) air-to-air infrared tracking missile, which has a limitation-of-firing angle when pointed toward the sun, cutting its effectiveness in this area.

Later on, the Hughes GAR-1D Falcon or the Raytheon Sparrow III probably would be used. Choice of a future missile will be decided by the type of aircraft fire control system selected by Japanese Defense Agency. Systems under consideration and competing are a modified Hughes MG-10 system and a modified Westinghouse Aero-13G system.



Nike Zeus Blast Pit Completed

Blast pit for Nike Zeus anti-missile missile launch complex is completed at White Sands, N. M., Missile Range; end view of the launcher is at the lip of the deflection pit. Facility is part of a $4 million construction job in preparation for Nike Zeus tests.

amendment to the Fiscal 1960 defense budget which would have barred contracts to companies hiring officers who had been retired from the military service for less than five years was narrowly defeated on the promise that the Armed Services Committee would undertake the investigation and consider legislation in the field. The amendment, sponsored by Rep. Alfred Santangelo (D.-N. Y.), was first passed 130 to 131 on a standing vote, then defeated 125 to 147 on a teller vote.

'Unhealthy Situation'

Rep. Santangelo told the House that the influx of former military men into defense industries "is a very unhealthy situation and should be changed immediately. It can have a very definite effect on contracting policies and procedures within the Defense Department. It can result in unnecessary expenditures and waste."

He added:

"Persons within the Department who may be looking forward to possible employment within a certain organization after retirement can display partiality and favoritism without ever realizing it. Further, prominent military figures in retirement can have a great influence over their former subordinates who are still in the Department. Contact at social and professional gatherings between active and retired officers can provide a perfectly natural setting for influence and favoritism." The three measures being considered by Sen. Thurmond's subcommittee are:

- **Legislation sponsored** by Sen. Leverett Saltonstall (R.-Mass.), which was an outgrowth of last year's hearings on the Soviet military-space potential by the Senate Preparedness Subcommittee headed by Sen. Lyndon Johnson (D.-Tex.). Philosophy behind the bill is to accelerate the production of advanced weapons and cut back on handicapping reviews, checks and audits (AW Aug. 18, p. 26). With the sharp change in congressional attitude that has evolved, there is little likelihood of favorable action on this measure at this time.
- **Legislation sponsored** by Sen. John William (R.-Del.), which would rigidly tighten all negotiated procurement. It has gained substantial support in Congress. The only justifications for negotiation—instead of open bid—would be in cases where public disclosure of the procurement would involve national security or where a new-type product were involved. Reports on all negotiated procurements would be submitted to the U. S. Attorney General.
- **Legislation backed** by the 45-member New York delegation which would require increased competition in negotiation. The New Yorkers claim that, if there were more competition, aircraft and missile procurements now concentrated in the West Coast area would shift to New York and other eastern states afflicted with high unemployment.

Contract Control

In reporting improvements in fiscal control over contracts last week in the Hebert subcommittee, USAF Assistant Secretary Taylor cautioned the subcommittee that the controls should not be so extensive that they "defeat the primary mission of defense."

Gen. Samuel E. Anderson, commander of the Air Materiel Command, and Maj. Gen. W. A. Davis, deputy director of the procurement at AMC, sharply challenged earlier testimony by Air Force prime contractors that they—rather than USAF Weapon System Project Offices—are weapon systems "managers" of certain defense projects. The contractors were North American Aviation, Inc. (AW April 20, p. 31); Lockheed Aircraft Corp. (April 27, p. 31); and Convair Division of General Dynamics Corp. (AW May 18 p. 28).

From their testimony, Gen. Anderson said he "wondered if they really did know their function." Gen. Davis said: "It is the responsibility of the Weapon System Project Office to plan, program, direct and control all facets of the particular weapon system in consonance with the Air Force program without functional duplication of the work being performed by the contractor . . ."

USAF Radar Plans

Washington—Air Force plans to procure 25 new frequency diversity search radars and 24 frequency diversity height finder radars during Fiscal 1960. New type radar is less vulnerable to enemy electronic countermeasures and has greater range and altitude coverage than existing air defense radars it will replace (AW May 18, p. 23).

Seconds after drop from B-52 mother ship, X-15 emits white plume of hydrogen peroxide fuel used for control system operations.

X-15 Makes Successful Free Flight

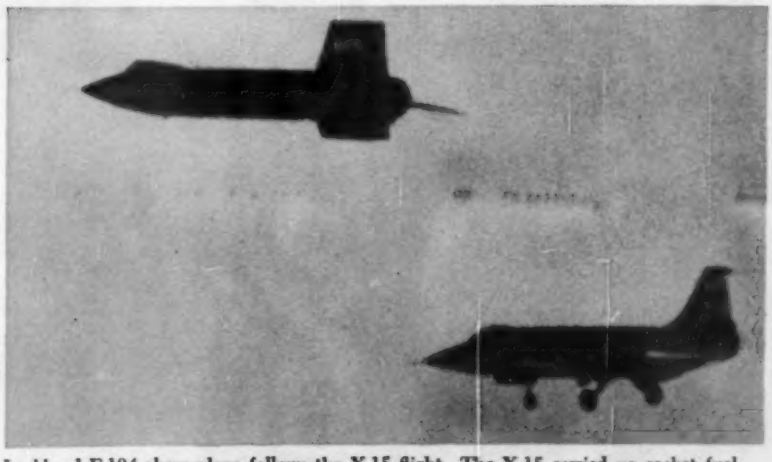
Edwards AFB, Calif.—North American X-15 upper atmosphere research aircraft dropped away from its Boeing B-52 mother ship last week to begin a successful 5 min. 10 sec. free flight before touching down at Rogers Dry Lake here. Test pilot Scott Crossfield termed the flight an unqualified success.

Released from the B-52 at a speed of Mach 0.80, the X-15 glided in a large S-turn during which the effectiveness of control handling and flaps was judged. The aircraft touched down at 160 kt. in a fairly nose-high attitude; friction of the two steel rear skids caused the nose wheel to contact the ground almost immediately with what appeared to be considerable force. Nose gear contact, however, was not as great as anticipated. Landing run was about 4,600 ft.

Ventral fin of the X-15 was jettisoned just prior to landing. During flareout, the aircraft porpoised through several diverging longitudinal oscillations; Crossfield said these were pilot-induced as he attempted to establish the degree of control effectiveness available in the landing configuration.

Drop altitude of 38,000 ft. was reached 20 min. after takeoff. Weight of the X-15 at drop was slightly more than 13,000 lb.

Next step in the series of demonstration flights that will be conducted by North American Aviation before turning the X-15 over to a joint National Aeronautics and Space Administration-Air Force-Navy team will be a captive flight at maximum gross weight.



Lockheed F-104 chase plane follows the X-15 flight. The X-15 carried no rocket fuel.

Rear skids have been lowered and ventral fin jettisoned to put X-15 in landing configuration. Note high angle of attack (top).

Boeing IM-99B Bomarc interceptor missile is delivered (left) in a Douglas C-124A Globemaster to skid strip at Air Force Missile Test Center's Cape Canaveral, Fla., assembly and launching area. At right the missile, on ground handling dolly, is rolled down ramp. Metal cover protects rocket nozzle.

USAF Test-Fires IM-99B Bomarc for First Time

Control and stability of Bomarc B during the first seconds of flight are provided by a jetevator annular vane in the booster, similar to those in Polaris and Snark boosters. External configuration of IM-99B is practically unchanged from the earlier IM-99A.

Bomarc B is moved to No. 4 launch pad. The missile has a Thiokol solid propellant boost rocket. Range of the Bomarc B is about 450 naut. mi., compared with about 250 naut. mi. for the Bomarc A.

Bomarc nose radome is delivered with protective cover to No. 4 launch pad. Bomarc B has the ability to sweep a corridor with its improved target seeker and strike any target it finds.

Bomarc IM-99B is fired for the first time. Cruise propulsion is delivered by two Marquardt RJ43-MA-7 ramjets (AW May 11, p. 72). Ramjet fuel is JP-4 rather than 80 octane, which simplifies logistics, since it is plentiful at USAF bases.

NASA Plans Telescope-Bearing Satellite

San Diego—Preliminary planning and some direct experimentation now is under way for a satellite astronomical observation platform, it was disclosed at the American Rocket Society semi-annual meeting here last week.

Information on the National Aeronautics and Space Administration project was presented by James Kupperian, Jr., of NASA Washington headquarters. He indicated that present thinking envisions a maximum telescope size of 36-in. as a part of a total 2,500 lb. payload, or an assortment of smaller size telescopes or combinations of telescopes and other equipment.

Orbit distance would be 500 mi. in a path as nearly circular as possible. After complete stabilization is accomplished, accuracy would be maintained to within 1 sec. of arc. Attitude stabilization and changes would probably be by means of flywheels, Kupperian indicated. Control would be remote, with the required instrumentation power obtained from solar-type sources.

The unmanned station would be used for a variety of purposes, Kupperian indicated. At the 500 mi. distance, in a perfectly circular orbit, the satellite expected life would be in the order of 200 years, and the end of the project or projects it was intended to accomplish would bring an end to the vehicle's usefulness rather than any normal type failure.

It was indicated also that such a satellite, rather than be allowed to remain in orbit after its usefulness was expended, might carry from launch a destruct provision which could be activated and the vehicle destroyed.

Preliminary planning which deals with "what do we want to do out there" than how do we do it, is now being accomplished, Kupperian said, since the Vega booster in two-phase configuration would be sufficient to accomplish the lifting and orbit injection tasks.

Space Smog

Among the factors to be considered in operation of such an astronomical platform, Kupperian said, is smog in space, which is a collection of debris which occasionally appears and reduces spatial visibility much as it is reduced by the ground-based phenomena which gave rise to the word. At its planned nominal altitude, the satellite would be inside the Van Allen radiation belts, allowing a certain degree of latitude in the method of gathering and transmitting to the ground the astronomical information gathered.

Useful tasks for the satellite would include corona studies, spectroscopic analyses of stars in the far ultraviolet spectrum, and observations in infrared which would be used to detect cold planets on the order of 10 light years distant.

As planned, according to Kupperian, the actual satellite would be composed of the telescope and its guidance and control equipment, with suitable shielding, rather than a separately designed vehicle with the telescope or telescopes and associated equipment added. This type of design would save weight and improve utility of the available 2,500 lb. aggregate payload.

One system described by Kupperian would be composed of a combination of six telescopes, each with the same orientation but with different filters to obtain different measurements of the same object under study.

Prior to the main astronomical observation platform being sent into orbit, a sun study would be conducted, and this now is in the planning stage, Kupperian said.

This would make use of equipment orbiting at 300 mi., and would use a Thor Delta as launching vehicle.

A new name for an old facility was described by Lt. Druce Pinc of USAF Ballistic Missiles Division. Called a "space crew holding facility," it essentially is a facility where space crews would stay and receive late stages and last up-to-the-minute training prior to a space flight.

The facility, which would be similar to those used in World War II before pilots were assigned to operational squadrons, would make much use of multiple capability simulation equipment and provide controlled living conditions to preclude infection of space pilots by such things as colds which could delay or abort special missions.

A facility which follows closely in the specifications for its design the parameters outlined by Pinc will be built at Cape Canaveral, Fla., for the Mercury astronauts.

The time during which space pilots would be held in the facility, Pinc said, varies in estimates of from four weeks minimum to 12 weeks maximum. During this period, the pilots would be able to work problems in multiple capability equipments such as centrifuges which are closed-loop systems reacting accord-

Armament Control

Wyandanch, N. Y.—Active and passive radar techniques will be combined in a new all-weather armament control system being developed for the Air Force for installation in two of its Century-series fighters. The passive technique, called Pacor (for passive correlation), has been developed and tested by the Astrionics Division of Fairchild Engine & Airplane Corp. under a $300,000 contract from Wright Air Development Center (AW July 14, p. 33). Pacor will be integrated with its complementary active radar system by Hughes Aircraft Co., prime contractor for the fire control system. Hughes awarded a $3 million contract to Fairchild 10 days ago for development and production of prototype equipments.

Pacor is an outgrowth of Fairchild's Padar (passive detection and ranging system) which obtains information on the location of enemy aircraft through reception of radar signals such as are radiated by a bomb-nav radar, determining azimuth and elevation directly and range data by measuring the time of arrival between the direct signal and the signal reflected from the ground.

Pacor apparently is a more sophisticated technique capable of operating from other types of electrical radiation, possibly such as might be generated by jammers or data link transmitters. One advantage of this type of combined fire control system would be that an attacking fighter could employ its active radar until the target attempted to defend itself with electronic countermeasures, at which time the passive system could take control and track the target by the radiated jamming signal.

Operational Atlas

San Diego—Limited operational capability will be achieved with the Atlas intercontinental ballistic missile at Vandenberg AFB early this summer, Maj. Gen. David Wade, commander of the First Missile Division said when questioned at the American Rocket Society meeting here last week.

Wade acknowledged that five recent Atlas failures, two with C models, three with D (operational) versions of the missile, will affect the time schedule to a degree, but refused to say to what degree. However, it is known that Atlas cannot be fired in the operational configuration from the operational site until clearance is given by the Air Research and Development Command subsequent to its successful launching of a missile of the same class.

Wade said he was unaware whether such things as the recent problems were allowed in Atlas timetable and whether, without these failures, the program would be ahead or behind this schedule.

Plans for a combination demonstration-operational shot of the Atlas is planned at Vandenberg soon, Wade said.

ing to control inputs. The equipment might also yield variations in heating intensity as a function of pilot control inputs so that emergencies could be simulated, raising pilot technique to optimum and cutting reaction time to minimum.

Mercury astronauts will work at this facility prior to their actual isolation here, Pinc indicated, adding that this also would be true of any future space crews; that is, they would do much of their later-stage work at the holding facility prior to being isolated just before their flight.

Here, Pinc added, problems of a family life and such have to be resolved to the G.I. attitude; i.e. a willingness of both sides to put up with the unusual circumstances which are inherent in military life and special duty assignments.

The facility also would be useful for post-flight debriefing, especially in re-creation as quickly as possible, under the best circumstances possible, of unexpected events which occurred during the flight. Additionally, he said, such re-creation could be best done in the multi-environmental equipments and multiple capability facilities which will be a part of the holding facilities. Re-creation here immediately after the flight would be much better than a written report, Pinc indicated. Col. John P. Stapp, president of the American Rocket Society and director of the Aeromedical Field Laboratory of WADC, said he believes that some of the most difficult problems in human factors connected with the Mercury project are not getting sufficient attention.

Stapp said that while there are some fixed problems in the project, there are a number of variable problems which must be solved with all variables being taken into consideration. One of these he posed was the problem of what happens to the space pilot during re-entry through the ionized layers such as those that extend between 100 and 200 mi. Also, what happens in a preprogramed re-entry when the pilot is unable to control the trajectory and a malfunction occurs? However, Col. Stapp declared that so far, the human factors work for project Mercury undertaken at WADC is going well.

There is a strong motivation for the best possible scientific and engineering effort in Project Mercury, Stapp said, since while the space pilot would die if a major malfunction occurred, those engineers and scientists who created the vehicle and associated systems would remain alive and would have to face public reaction, pick up the pieces and continue the project, as was the case in Vanguard, only with a greater loss than a missile.

Space Outpost 11 Details

San Diego—Details on Outpost 11, a five-ton satellite orbiting at 300 mi. from earth which could be used as a space laboratory and training station for space flight crews as well, were given to members of the American Rocket Society at the semi-annual meeting here. James R. Dempsey, manager of Convair-Astronautics Division, said the satellite would be boosted into orbit by a Centaur, composed of an Atlas booster topped by a 30,000 lb.-thrust Pratt & Whitney liquid oxygen and liquid hydrogen rocket engine.

The station is designed for four men plus equipment to perform basic investigations which require space environment to yield true and accurate data. Configuration has the crew area in conical nose section of vehicle. At launch, this is attached to the Centaur upper stage. After orbit injection and stabilization, the crew section is extended from empty Centaur tanks on two columns about 20 ft. long. This is done to get a long moment arm, since the station will rotate slowly about its longitudinal axis in order to provide a $\frac{1}{6}$th normal gravity for station occupants.

Space Technology

Jupiter Test Indicates Division Of Cells Can Develop in Space

Washington—Cell division and the fertilization process can survive and continue to develop in a space environment.

Survival and growth capabilities were confirmed in one of four experiments housed in a Jupiter intermediate range ballistic missile which also carried two small monkeys over a 1,500 mi. range and to an altitude of 300 mi. on May 28 (AW June 1, p. 37; June 8, p. 30).

In the experiment, six vials were launched containing sea urchin eggs in both fertilized and unfertilized conditions. Eggs in two of the vials were fertilized when they were placed in the nose cone approximately 8 hr. before launch. Those in the other four vials were fertilized by a triggering mechanism during acceleration.

Dr. Richard S. Young, biologist at the Army Ballistic Missile Agency's Research Projects Laboratory, which conducted the test under National Aeronautics and Space Administration sponsorship, said last week that the prefertilized eggs continued to develop during the flight which included extreme vibration, acceleration stresses, exposure to radiation and about 9 min. of weightlessness. The cells were still developing late last week.

The eggs fertilized during flight, however, disintegrated at some point during flight. Dr. Young, who described the experiment as a whole as "generally encouraging," said the disintegration may have been caused by the vibration effects encountered during the flight and re-entry or possibly an improper mixture of the fixative added to the vials during the re-entry period in an effort to stop the development of the eggs and permit a study of the tissue that had been created under a space environment. Prefertilized eggs, Dr. Young said, have much greater resistance to vibration than unfertilized eggs.

ABMA scientists believe that the disintegration of eggs fertilized in flight can be overcome in future experiments by further cushioning of their vial containers and by resorting to a different fixative.

Dr. Young studied the results of the experiment at Ft. Brooke, San Juan, Puerto Rico, initial stop of the Navy tug which recovered the Jupiter nose cone.

Final preparation of the experiment at the Air Force Missile Test Center complex at Cape Canaveral, Fla., and placement of the vials aboard the nose cone were carried out by Dr. Charles Metz, of the Florida State University and an ABMA consultant, and Don Cochran, of ABMA's Research Projects Laboratory.

The Research Projects Laboratory also was responsible for coordinating the other test tube biomedical experiments carried in the Jupiter nose cone. Four of these—using human blood, onion tissue and seeds, fruit fly larvae and yeast in a study of radiation effects—were sponsored by the Army Medical Research Laboratory at Ft. Knox, Ky. The Brookhaven National Laboratory, Upton, N. Y., sponsored a fifth experiment to determine the effects of radiation on corn germination. Data on these experiments is still being reduced.

The equipment necessary for all the biomedical experiments was built by ABMA's Structures and Mechanics Laboratory.

USAF Flying and Static Displays Dominate 23rd Paris Air Show

By David A. Anderton

Paris—Unless the Russians pull a last-minute surprise, this 23rd International Aeronautical Salon will be dominated by the flying and static displays of the United States Air Force.

Three of the Century-series fighters—McDonnell RF-101, Convair F-102 and Lockheed F-104—have scheduled a combined flight presentation. These plus the North American F-100, Douglas RB-66 and Lockheed C-130, all from operational units stationed in Europe, will be on static display. The Boeing KC-135 and Douglas C-133 will also be shown.

One planned event is an overflight of a Boeing B-52 which will take off from New Mexico, fly nonstop over Alaska to Paris, roar over the show and then go on to land at a USAF base in Morocco.

USAF is also throwing in a heavy aero-space exhibit, with a mockup of the North American X-15, Thor capsules and some space mice. Missiles on display will include the Convair Atlas, Douglas Thor, Boeing Bomarc and Martin Mace.

In complete contrast to the last salon in 1957, French contributions are much fewer and less exciting. The technical brilliance of their designs highlighted the 1957 salon and impressed foreign observers with the skill of their French contemporaries. Now the only new aircraft scheduled by the French are the Dassault Mirage 4, the Sud 3200 helicopter, Snecma coleopter and the Max Holste Super Broussard.

But at show time, flypast of the Mirage 4 was still uncertain because the airplane had yet to make its first flight. All-night driving labor by Sud Aviation technicians got their big helicopter into the air at 5 a.m. the day before the show. Also the day before, Snecma specialists were still trying to decide whether or not to attempt their first actual in-flight transition of the coleopter during the flying display.

The Russians promised to send over two of their standard service airliners: the now familiar Tu-104B and Il-18.

Four acrobatic teams are spotted during the flight demonstrations: USAF Skyblazers, RAF 111 squadron, Italian Black Lancers and the French Mystere Patrol.

The U.S. Navy canceled out completely on the ground that it had no money to participate in such displays. This disappointed not only the remaining protagonists of naval air power, but several U.S. manufacturers whose past and future product lines have been heavily loaded with Navy orders.

The U.S. Army will demonstrate helicopters and also show Nike Ajax, Nike Hercules, Honest John and Redstone missiles which are now deployed in Europe.

FAA Fines Pilot, Pan American

Washington—Federal Aviation Agency has levied fines of $1,000 each against Pan American World Airways and Capt. W. Waldo Lynch, Jr., who was in command of a Boeing 707 jet transport which made an uncontrolled dive of 30,000 ft. over the North Atlantic last February (AW Feb. 9, p. 39). The agency also notified Capt. Samuel T. Peters, first officer on the flight, that it plans to suspend his transport pilot rating for a period of six months. Both are supervisory pilots; Lynch is Pan American's assistant vice president-communications, and Peters is chief pilot of the Pacific-Alaska Division.

Basis of the fine against the airline was Pan American's failure to keep a flight recorder in operation in accordance with Civil Air Regulations requiring continuous recorder operation for aircraft flying above 25,000 ft. Pointing out that the airline permitted the aircraft to remain in schedule after its recorder tape was exhausted, FAA said that it was not until after the dive incident that Pan American spelled out correct procedures for tape replacement. The agency said Pan American also permitted the plane to depart from New York International Airport three times with an inoperative recorder, which constitutes three separate violations.

Capt. Lynch was found guilty of violating both Civil Air Regulations and company rules requiring the captain and first officer to remain at the controls at all times whenever the crew consists of only two pilots. Citing the high performance characteristics of the Boeing-707 and the fact that the aircraft had previously experienced autopilot malfunctions, FAA said Lynch should have determined that the first officer was fully prepared to take manual control of the aircraft in the event of another malfunction while he was absent.

The agency also said the Mach trim tab, designed to prevent the 707 from tucking under at high speeds, was found in the off position when Lynch returned to the cockpit. FAA said the tab may have been turned off by a flight crew member after completion of the checklist or overlooked after takeoff but added that its disengagement was believed to be a major factor in forcing the aircraft out of control. The agency said this combination of events all contributed to make Lynch's absence from the cockpit all the more serious since as pilot-in-command he was responsible for the safety of the flight and the conduct of the crew at all times.

FAA said Peters' transport pilot rating will be suspended on grounds that he was not sufficiently alert in taking over the controls of the jet in time to prevent the uncontrolled dive. Peters is now appealing the ruling.

Cessna Studies Plant In Latin America

Negotiations for a plant that would assemble business and private planes are being studied by Cessna Aircraft Co., Wichita, Kans., and the Argentine government. Top Cessna officials will leave soon for Argentina to study feasibility of the project. Included in the party will be Del Roskam, vice president-aircraft division; Frank Boettger, vice president-treasurer; Chris Hesse, commercial division works manager, and M. F. Mellinger, export manager.

Anti-Radar Missile Planned by Air Force

Washington—Air Force request for $23 million to develop an air-launched anti-radar missile designated WS-121B and intended to home on the electromagnetic energy of enemy radar stations has been approved by the House Appropriations Committee.

The proposed new USAF missile will perform a mission similar to that of Navy's Corvus under development by Temco but presumably will have longer range, perhaps on the order of 500-mi. or more. Range of the Corvus is approximately 75 mi. Unlike the Corvus, which must seek out radars on moving ships, WS-121B will be used only against stationary radar installations.

In theory, it is possible for a bomber equipped with an extremely sensitive ferret receiver to detect radiation from an enemy radar before the radar detects the bomber. The reason is that only a fraction of the energy striking the bomber is reflected back to the radar, and this low-level echo is reduced further by the return trip back to the radar. For this reason, it may be possible to detect an enemy radar, launch an anti-radar missile and knock out the station before it detects the presence of an intruding bomber.

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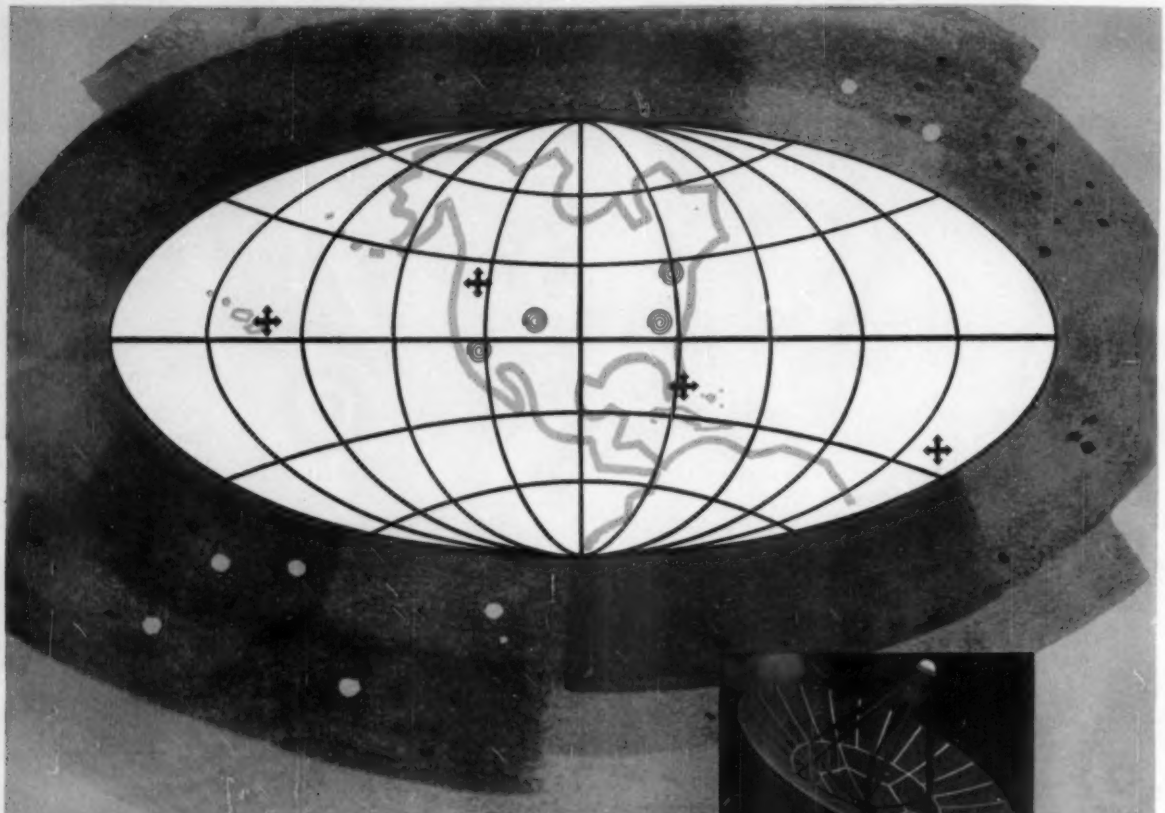

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IMPORTANT CAREER OPPORTUNITIES NOW OPEN

Thiokol Finds Promising Approach To Solid Boron Rocket Propellant

Denville, N. J.—Solid boron rocket fuel has moved much closer to production owing to the development of a new class of boron molecules by the chemical research group here at Reaction Motors Division of Thiokol Chemical Corp.

Identified only as carbon derivatives of boron hydride, with the general formula $B_xH_yC_z$, this new group of molecules is expected to lead to new high energy boron fuels which can be put into development and test fired on a large scale by the end of the year.

In combination with the advanced oxidizers such as nitrylperchlorate now under development by Advanced Research Projects Agency contractors, the new boron fuels will provide 10% more power than present solid propellants, according to Reaction Motors researchers. Even with conventional oxidizers such as ammonium perchlorate, the new fuel is expected to show a slight gain over present solid fuels. But the reaction between the new boron fuels and conventional oxidizers will not produce the type of combustion products required for a significant energy gain.

Reaction Motors researchers have been firing solid boron fuels for a year. Up until this time, however, they have not been able to get enough boron hydride groups into the fuel polymer to produce sufficient energy to make it worthwhile to put the fuels into development.

Working on the problem since 1956 under a prime Air Force contract, the Reaction Motors group has been trying to put boron hydride into a solid fuel polymer in place of the usual carbon atoms. Ideally, the group would like to substitute boron atoms for all carbon atoms and produce a completely inorganic polymer. But at present this appears to be impossible and, from what is now known, some carbon atoms will always be required to extend the polymeric fuel chain.

Getting any of the conventional boron hydride groups into the fuel polymer, however, proved to be a difficult problem in itself. The conventional boron hydride molecules were too reactive and united with the wrong chemical elements, preventing the proper cross-linking and extension of the polymer chain to produce the desired solid propellant configuration. Moreover, when a few boron atoms were successfully substituted for carbon atoms, the resultant fuels were usually shock sensitive.

Then, in 1957, Reaction Motors chemists developed a new carbon-boron structure. But as in many scientific developments, the significance of this new class of boron molecules was not realized immediately. Later it was discovered that the new group could undergo reactions that the conventional boron hydride molecules could not. Moreover, this new class of boron molecules did not interfere with the reactions required to produce the desired monomers and polymers. Nor did the final fuels prove shock sensitive.

For the past year, the Reaction Motors group has been working on developing the full potential of this new class of boron hydride derivatives, making new derivatives, substituting more and more of them into solid fuel polymers, and test firing them on a small scale. By the end of the year, the group expects to have what it has been seeking for the past three years—a solid boron rocket fuel with enough energy to merit consideration for production.

Meanwhile, a number of chemical companies have been working on the development of new solid oxidizers for the boron fuel during the past year under contracts from the Advanced Research Projects Agency (AW Nov. 3, p. 34). Some of them have reportedly made important progress in their programs and are expected to have new oxidizers available for testing within six months.

Hydrazine Fuel

Reaction Motors Division of Thiokol Chemical Corp. may soon switch its prepackaged liquid rocket powerplants to hydrazine fuel in an effort to match the power potential of solid propellant rocket engines. Hydrazine is combination with a more energetic oxidizer such as chlorine trifluoride will compete with operational solids on a density impulse basis and will surpass them in straight specific impulse, according to Reaction Motors. Present prepackaged units, now in production at Thiokol's Bristol (Pa.) plant for Sparrow III and Bullpup, are still tanked with mixed amine fuels and inhibited red fuming nitric acid oxidizer.

At present the hydrazine project is at the "second level of development." The company is carrying out test firings and performing storage and thermal decomposition studies. The most serious problem to date has been hydrazine's high freezing point (34.5F). Reaction Motors researchers believe they have now overcome the problem through the use of additives which will enable them to meet the military requirement for a minus 65F freeze point without significantly affecting hydrazine's density or energy. A number of other companies, including de Havilland Aircraft Co., Ltd., are now showing active interest in the prepackaged units.

News Digest

Lt. Gen. Clarence S. Irvine, who retired April 30 as Air Force deputy chief of staff for materiel, has been appointed vice president and director of planning of Avco Manufacturing Co. Gen. Irvine, who began his military career in 1918, served as deputy commander for production and weapons system, Air Materiel Command, before becoming deputy chief for materiel in 1955.

Third-stage engine for solid fuel Minuteman intercontinental ballistic missile will be developed by Hercules Powder Co. after a $15,326,000 contract awarded by USAF's Ballistic Missiles Center. Majority of the work will be done at Bacchus, Utah.

Sperry Gyroscope Co. Division of Sperry Rand Corp. has received contracts totaling $47 million for development and production of AN/FPS-35 air search radar systems. The high powered radars will be integrated with the Continental Aircraft Control and Warning System for detection and identification of aircraft and air breathing missiles. First AN/FPS-35 is under construction at Thomasville Aircraft Control and Warning Station, Ala.

Commercial agreement to operate regular air service between Vienna and Moscow has been signed by Aeroflot and Austria Airlines. Austria Airlines' inaugural flight was made by a Vickers Viscount turboprop transport.

Electronic Industries Assn. estimates U.S. will spend more than $14 billion for civil and military space technology through Fiscal 1970, of which approximately one-third ($4.8 billion) will go for electronics. During the same period, the percentage of National Aeronautics and Space Administration's budget devoted to electronics is expected to rise from 20% to nearly 45%.

Navy Bureau of Ships has awarded a multi-million dollar contract to Sylvania Electric Products, Inc., for development of communication systems for the Polaris missile program.

North American Aviation plans to acquire the **Foster-Wheeler Corp.** were dropped last week.

Continental Streamlines Jet Ticket Plan

'Train-conductor' plan for in-flight collection and sale is adopted to handle traffic volume.

By L. L. Doty

Chicago—Continental Air Lines inaugurated its Boeing 707-120 service to Los Angeles last week with a new ground handling program tailored to cope with the swelling volume of traffic the turbojet transports are expected to generate.

The program—unique in the airline industry but commonplace among surface transportation operators—is designed to eliminate the time-consuming details of passenger check-in on jet flights. It is based upon the train conductor principle—the collection and sale of tickets aloft rather than on the ground.

With the new program, Continental believes that passengers may be able to arrive at the airport as late as 20 min. before flight departure time and board the aircraft without undue rush, whether they are ticketed or not. The new procedures are keyed to the high seating capacity of the jet transport.

110 Seats

Continental's four Boeing 707-120s —involving a total investment of $23.8 million—are designed with a configuration of 110 seats. The first-class forward section includes 48 seats; the coach cabin seats 62 passengers. The airline holds an option on a fifth 707-120. It also plans to purchase a fleet of Boeing 707-320 intercontinental turbojets or turbofan-powered 707-120Bs if it is successful in its bid for nonstop routes to Honolulu from Chicago, Denver, Kansas City, Los Angeles and San Francisco.

The airline has started its Boeing service with one nonstop daily round trip flight between this city and Los Angeles.

The service will be expanded on Aug. 8 to include Denver and Kansas City, and, later this summer, the carrier expects to operate a total of six daily round trips between Chicago and the West Coast.

Continental is the first of the eight regional carriers to introduce turbojet service on its routes.

Ground Handling

To simplify its ground handling procedures on the turbojet operations, Continental is treating each flight as two flights—a coach trip and a first-class trip. Flight designation will be confined to small numbers to help passengers remember the flight on which they hold space.

For example, a coach passenger may hold space on flight 3C while a first-class passenger, if he is on the same airplane, would hold space on flight 3F. Coach and first-class passengers are separated at the gate and board the aircraft through separate entrances.

Only two steps are required of a passenger: he must check his baggage at the ticket counter and must identify himself, his flight number and his destination at the loading gate.

All ticketing, advance reservations, collection of excess baggage fees and other steps formerly handled at the airport ticket counter are now handled aloft.

Added Crew Member

For this purpose, Continental has added another crew member to the three flight officers and four stewardesses it carries aboard all turbojet flights—a passenger service agent. The passenger service agent is equipped with a small cart—a mobile ticket counter which contains ticket stocks, cash drawer, vali-

SAS, Northwest Plan Link

Around-the-world link between Scandinavian Airlines System and Northwest Orient Airlines is likely to result from an agreement between SAS and Thai Airways, Aviation Week has learned. If the two-step deal comes off as planned, SAS and Northwest will participate jointly in operations of the Thai carrier and will be able to fly their own aircraft over the Thai Airways Bangkok-Hong Kong-Tokyo route. From any of these points, SAS and Northwest would offer connecting service east across the Pacific to the U. S. and west via Karachi to Europe.

Both airlines now serve Manila, where Northwest connects with Trans World Airlines flights from Bangkok and SAS goes on to Tokyo and the polar route to Europe, but neither now serves Hong Kong, and SAS has no Pacific link to the U. S. West Coast.

The two airlines also would benefit from a built-in feeder network through their participation in Thai Airways.

Breakdown of the deal:

- **"Thai International Airways" is set up as a corporation owned 70% by the Thai government and 30% by SAS. The Scandinavian carrier signs a 15 year contract covering management, operations, sales and development of the new carrier. SAS agrees to assume 100% of the financial risks and profits at the beginning, with this relationship gradually brought to a 50-50 basis.**
- **Northwest signs an agreement with SAS, taking over one half of SAS's share in all phases of the arrangement. The two big airlines also work out their own service over the Bangkok-Hong Koag-Tokyo route.**
- **SAS buys for $4 million three Thai Airways Lockheed Super G Constellations, which probably will go to Guest Airways of Mexico, with whom SAS also has an agreement and an interest. Northwest will underwrite any loss involved in this transaction, although none is expected.**

First phase of the trilateral deal, according to Aviation Week's sources, will be made formal imminently by Thai government approval. The SAS-Northwest agreement is expected to follow shortly.

Thai Airways formerly operated for a time under a management contract with Pan American World Airways, but this was allowed to expire. Reported reason was dissatisfaction on the part of the Thai government. Northwest Airlines then signed a contract with Thai Airways, but was forced out of it by Civil Aeronautics Board refusal to approve.

Thai Airways now has Douglas DC-3 and DC-4 equipment in addition to the three Super Gs. For operation of Thai's own Far Eastern services, SAS and Northwest will, under the agreement, provide what additional equipment is needed.

dator and universal, air travel plan forms.

Continental is not worried about passengers who may board the aircraft without confirmed space. If the plane is not filled, the airline gains an extra sale. If it is sold out, it can accommodate oversold passengers in its six-seat lounge. Seats in the lounge are sold only in the event of an oversale so that a buffer is always available.

At the time original reservations are made, passengers are asked if it would be convenient to pick up tickets in advance. No limit on ticket pick-up time is imposed on any passenger who prefers not to purchase his ticket in advance of the flight. He is ticketed aloft by the passenger service agent—a traffic expert with an average seniority in station operations of eight years.

Excess baggage also is collected aloft from information channeled to the passenger service agent from the ticket counter agent who has weighed and checked the passenger's baggage. All reissuance of tickets and revised itineraries are handled in flight.

Passenger manifests are held in the reservations office. The gate agent stays in constant telephonic communications, through the use of a head set, with the reservations agent handling the manifest. Passengers are checked off the manifest as they pass through the gate and give the gate agent their names and destinations—information which is relayed to the reservations agent.

Passenger service agents are available at the beginning and end of each flight as well as during flight and provide personalized special services the passengers may require. The program, which has been tested on some of the carrier's Vickers Viscount turboprop flights, was a marked success on both eastbound and westbound inaugural flights of the 707, with capacity loads being accommodated with no delays, congestion or confusion among the passengers.

Continental is practicing another innovation on its jet flights—the use of a three-man "safety crew." Safety crews, rigged in gold-colored safety helmets and coveralls and equipped with walkie-talkies, are responsible for the ground movement of the aircraft and mobile units servicing the aircraft.

Two members of the crew are "wing-men." The third directs the pilot in approaching and leaving the gate position through information received from the wing-men. All three safety agents keep in radio communications through the walkie-talkie equipment with drivers of fuel trucks, food service trucks, loading ramps, air conditioners and other equipment used in turn-around operations. Operators of such equipment move under direct instructions from the ground safety agents. Ground and flight crew training has cost the airline about $750,000. However, the carrier is making the transition to the turbojet aircraft with a minimum of difficulty.

Officials aboard the inaugural flight pointed out to AVIATION WEEK that experience with the Viscount has assisted in making the switch to turbojet.

The cabin interior of Continental's Boeing aircraft was designed by Charles Butler of New York. Walls are made of aluminum alloy panels on which silk-screened vinyl plastic has been laminated. No window curtains are used but each window is equipped with an opaque sliding window-blind.

CAB Counsel Proposes Approval Of American Express Freight Bid

Washington—Civil Aeronautics Board attorneys last week recommended the granting of air freight forwarder authority to the American Express Co. despite protests by objecting forwarders that the applicant's service, combined with its world-wide banking and shipping interests, could result in an American Express monopoly.

Citing the many public benefits American Express could offer in the field, the Board's bureau counsel said the company should be allowed to operate as an air freight forwarder for an experimental five-year period under a Letter of Registration. Answering the opposing forwarders, the CAB attorneys said the recommendation carries the following stipulations designed to avert any possible unfair competitive practices and, at the same time, permits CAB to keep the operation under close scrutiny:

- **American Express Co.** would be prohibited from carrying any shipment where it had advanced financial aid to a merchant, manufacturer or shipper for the purchase price of the freight involved. Banking interests of American Express constitute a "potent advantage" over competing forwarders, the bureau counsel said.
- **Company would have to include** the descriptive phrase "an international air freight forwarder not connected in any way with the Air Express Company." The attorneys said this description was needed to avoid any possible confusion with companies as the Railway Express Agency and American Airlines.
- **All forwarding operations** of American Express would be in strict accordance with the Letter of Registration issued.
- **The company may not act** as a general shipping agent for any direct air carriers and must file all existing agreements with surface carriers, such as the Railway Express Agency, New York Central Railroad and Greyhound Bus and with the CAB to avoid any possible conflict of interest.
- **No air freight may be** shipped under an agreement with the Railway Express Agency without the prior approval of the Board.

The stipulations by the bureau counsel were designed to answer objections filed by the Air Freight Forwarders Assn. and Air Express International, who told the Board American Express could exert "tremendous economic power" through its "myriad of affiliates."

Summing up the many business interests of the applicant, Air Express International told the Board it had no objection to "bigness for bigness alone" but feared that the inability of most competing forwarders to meet American Express financial resources would give the larger company a virtual monopoly.

In particular, Air Express cited a reported American Express statement that the firm might extend letters of credit for the purchase or manufacture of products customers may want to ship.

Profit From Banking

The applicant, Air Express charged, could thus profit from both its banking and shipping interests and, at the same time, offer lower rates than competitors.

Large reserves of foreign exchange also held by American Express would allow the company to make an additional profit whenever favorable exchange rates are available, Air Express contended in its petition to the Board.

Primary question before the CAB, Air Express said, is the "novel question" of whether it should authorize a "bank to engage in air freight forwarding" since "nowhere in the transportation field is a bank permitted to act as a carrier."

Air Express also referred to the American Express relations with the Railway Express Agency as a "built-in loyalty to surface transportation" which could result in the agency's extending its present shipping of small packages overseas to air freight shipments since American Express would probably "favor the rails."

Meetings between executives of Railway Express and American Express, Air Express said, "indicate that their business connections run too deep" to authorize the applicant as an air freight forwarder.

Fifty-five 707s rolled out for seven airlines

Fifty-five Boeing 707 jetliners, bearing the colors of seven famous airlines, have rolled out of Boeing's Renton, Washington, plant. Nearly 35 have been delivered. In all, 190 Boeing 707s and 720s have been ordered by 16 airlines and by MATS.

Already, 707s are in scheduled service by Pan American, American, T.W.A. and Continental airlines. Soon Qantas will begin 707 operations. Deliveries, later this year, will be made to Braniff, B.O.A.C., Air France and Sabena.

707s are also in production for Air India, Cubana, Lufthansa, South African Airways and Varig. In addition, 720s are on order for American, United and Irish airlines.

Since going into service last October, the 707 has attracted the highest load-factors of any airliner in aviation history. These range from 90 to 95% and indicate the unparalleled profit potential of Boeing jetliners.

Currently, 707s are carrying more than 3500 passengers a day. Already more than 300,000 air travelers have flown aboard the 707.

Boeing jetliners now in scheduled service are demonstrating tremendous earning power, extremely high initial utilization and unprecedented public acceptance.

BOEING 707 and 720

Airlines List Objections to Fare Proposal

By Robert H. Cook

Washington—Airline attorneys are regrouping their tactical arguments to combat a recent Civil Aeronautics Board examiner's decision in the General Passenger Fare Case.

Hoping for a larger fare increase than recommended based upon a "more realistic" method of computation, eight carriers have filed exceptions to the initial decision of Examiner Ralph L. Wiser who called for a 12% fare increase to be computed on a rate of return on investment formula (AW June 1, p. 38).

Major areas of objection voiced by the carriers are:

- **Suggested 12% increase** above that in effect prior to Feb. 10, 1958, will not cover planned operational expansion. In general, the airlines repeated their demands for fare increases ranging from 12.5 to 20%.
- **Rate of return formula** recommending 10.25% for American, Eastern, Trans World and United and 11.25% for the remaining eight trunk carriers was rejected by most of the airlines who say the suggested percentages should be at least 13%. Basic airline argument advanced is that the formula is simply a "borrowed yardstick" historically applied to old line public utilities with low capital turnover.
- **Depreciation policy recommended** does not recognize practical service life of existing aircraft. Many carriers view this recommendation as a repetition of a CAB enforced depreciation policy put into effect in 1957 but defeated in court action by the airlines the following year. While the carriers would still follow their own depreciation formulas, the plan suggested by the examiner would play a key part in the final determination of rate of return, airline attorneys said.
- **Rapid increase in cost** of labor and materials may outstrip Wiser's prediction that new flight equipment will result in greater employe productivity measured in terms of available ton-miles per employe.
- **Once the recommended** fare levels were placed in effect, it would be competitively impractical for any airline earning less than a fair return to file higher tariff charges as suggested by the examiner.

Northwest Airlines was among the most outspoken critics of the examiner's rate of return plan which it termed unfeasible and a "maze fraught with errors." A majority supporter of an operating margin formula, the airline criticized the complexity of the recommended formula.

American and United, however, voiced tentative approval of a rate of return based upon investment, with American stipulating that the formula also should be designed to avoid realizing less than a 7% return margin on revenues. Both rejected the percentage rate recommended as too low and called for at least 12%.

Strong protests were filed by most carriers against Wiser's depreciation policy which would place a seven-year depreciation on piston aircraft and engines and a 10-year life on turboprop and turbojet airframes, with a five-year service life for turbine engines. Wiser further recommended a 15% residual value for all flight equipment except turbine engines which would have a zero residual value.

Estimated Loss

In earlier objections filed by American in opposition to CAB's enforced depreciation policy in 1957 and 1958, the carrier said it would have lost an estimated $30.3 million on its Douglas DC-7 fleet purchased since 1956 and to be fully depreciated by 1961 on a common retirement date. Retiring the fleet under the company's own depreciation schedule will result in a residual value of $11.2 million by the end of 1961, the airline said.

Delta also complained of the 10-year service life on piston planes and cited its fleet of used Lockheed L-049 Constellations offered for sale since 1957 with no prospective buyers. The airline said it placed a three-year depreciation period on these planes. Capital also took issue with this point, questioning the validity of the examiner's depreciation policy in view of its fleet of Vickers Viscount turboprop aircraft and the many new aircraft now entering the market.

ATA Stand

The Air Transport Assn., which said it viewed the entire decision as "disappointing," warned that any CAB move to establish depreciation policy could hamper the ability of the airlines to adapt to new equipment developments in the future. In particular, ATA said, any earlier-than-expected development of supersonic transports could seriously affect a rigidly imposed depreciation policy.

Delta also raised the question of how much benefit would accrue to trunklines under the examiner's plan to add $1 to each ticket. Most of this extra fare, Delta said, would have a greater impact on short haul carriers although local service airlines are not a part of the case. Delta estimated that 40% of its passengers take connecting carriers so that the surcharge would be split between two airlines. Such a procedure, it said, would result in the airline collecting only 70 cents more per ticket. In addition, the carrier voiced concern that many local service airlines might not impose the $1 surcharge, thus forcing Delta to take the same action as a competitive measure.

ATA Complains to CAB

Washington—Air Transport Assn. complained to the Civil Aeronautics Board last week that CAB investigators are often gaining access to confidential papers in cases in which ATA and the Board's staff are adversaries.

At the same time, ATA advised the Board that it cannot comply with a CAB request for 500 ATA documents which the organization contends are the legal property of its members alone. The Board had requested the papers to aid in its investigation into the scope of ATA's activities (AW Mar. 30, p. 42).

In a letter to CAB Chairman James R. Durfee, ATA pointed out that two of four CAB investigators, currently examining ATA records by order of the Board, also are CAB attorneys opposing ATA in the Air Traffic Conference Case, which is still pending. The association advised Durfee that it has no reluctance to deny such material to the Board but objected on the grounds that it should not be made available to the CAB staff until after a Board decision in the case has become final.

Replying to a CAB request that ATA decide whether to withhold the contents of 500 documents as legally privileged material, the association told Durfee the choice would first be up to ATA attorneys. As a second step, ATA said the documents in question are the property of its individual airline clients who have been informed of the CAB request. The association said it would make its own determination of which documents involving ATA officers are privileged. ATA also noted that Board investigators have now examined 350,000 ATA documents with 1,300,000 more remaining to be examined. Setting aside the few documents, under tentative legal consideration, has had little effect on the scope of the investigators' task, ATA said.

CONTINENTAL'S VISCOUNT NET PROFIT $1.3 MILLION IN FIRST 7 MONTHS!

With an average fleet of nine* new Viscount 810 (Viscount II) jet-props, Continental Airlines recently reported a net profit of $1.3 million. Direct cost per plane mile was 71.33 cents—nearly 11 cents below budget. These figures confirm those for the first four months of Viscount operation which showed that, with a break-even load factor of only 37.3%, the Viscount was easily the most economical to operate of Continental's aircraft.

Mr. Robert Six, President of Continental, paid tribute to the Viscount's major contribution in the airline's $1 million operating profit for the fourth quarter of 1958. And he looks forward to 1959 as "the best year in the airline's 25-year history."

BOARDINGS UP 90% IN CHICAGO

The popularity of Continental's Viscounts played a leading part in boosting the airline's 1958 boardings 90% in Chicago—and 67% in Los Angeles.

Mr. Six has high praise for the Viscount. He reports that "Performance, passenger appeal and economies of the Viscount II have exceeded all expectations. The public has shown great response. The Viscount II is ideally suited for medium-length distance and pilots have shown a great enthusiasm for its handling qualities."

For further information on the bigger, faster new Viscount II, contact Christopher Clarkson, U.S. representative, 10 Rockefeller Plaza, New York 20, N. Y.

*Continental's Viscount II fleet average was nine for the 7-month period ending December 31, 1958. Delivery of the airline's total order of 15 new Viscounts is now complete.

FROM THE WORLD LEADER IN JET-PROP AIRCRAFT...

VICKERS VISCOUNT 810/840 POWERED BY FOUR ROLLS-ROYCE DART ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LTD. • WEYBRIDGE, ENGLAND • MEMBER COMPANY OF THE VICKERS GROUP

Reliability Survey of KC-135 Aids 707

Washington—Detailed operational studies of the Air Force KC-135 jet tanker are being used by Boeing Airplane Co. to increase the reliability factor of its 707 jet transports.

Information compiled from an 11-month survey of the military aircraft already has proved to be of value to many airline operators who are realizing a significant percentage increase in their predictions of completed flights as a result of Boeing's intensified reliability program.

Application of the manufacturer's study was evolved from a theoretical analysis of the life expectancy and failure rate of all components on the KC-135 and its comparison with a practical study of the actual component failure rate on 16 of the military aircraft at four Air Force bases within the U. S. Results for both military and commercial models of the four-turbojet transport have been broken down into mathematical formulas, carded for electronic data processing machines and passed on to Boeing engineers, the Air Force and commercial users of the 707.

Purpose of the Boeing reliability study is to arrive at a method whereby it can accurately design and manufacture its aircraft and parts with a degree of accurate reliability in order to allow a reasonable prediction of the percentage chance of completing a military mission based upon the time length of the flight.

With some variations to allow for different operating procedures, the formulas are being applied to commercial use.

Key to Formula

Key to the formula centers around known component failure rates. This allows Boeing to suggest several alternatives whereby the flight, military or commercial, may still be realized by either improving designs of existing parts or adding components or new accessories to cut the mathematical changes of an in-flight failure which would force a cancellation.

More than 2,000 malfunction reports on 16 KC-135s were received during the study period, according to Boeing. Monthly reports covered 4,600 aircraft hours and flight times per plane. This information, along with reports from airline operators of the 707, is passed on to management, tabulated on computer cards and used as a basis for further research and design by Boeing engineers.

The reports list each malfunction as to the designated component, number of flight hours, maintenance time to service, and condition under which the malfunction occurred. By this means of check and double check, both in theory and actual practice, Boeing feels it has arrived at a means of controlling the reliability already built into its aircraft. Information is not only of current value but is expected to be used in future aircraft designs which may incorporate a number of components now being used on the KC-135 and the 707.

Reliability predictions being made on the jet tanker are now measured in terms of a typical 6-hr. mission, with a detailed breakdown of expected component lifetime between failures.

The predictions are designed to assure better than a 95% completion factor, depending upon the flight conditions.

Applying Formula

Application of the manufacturer's formula for commercial flights has been centered primarily upon economy of operation.

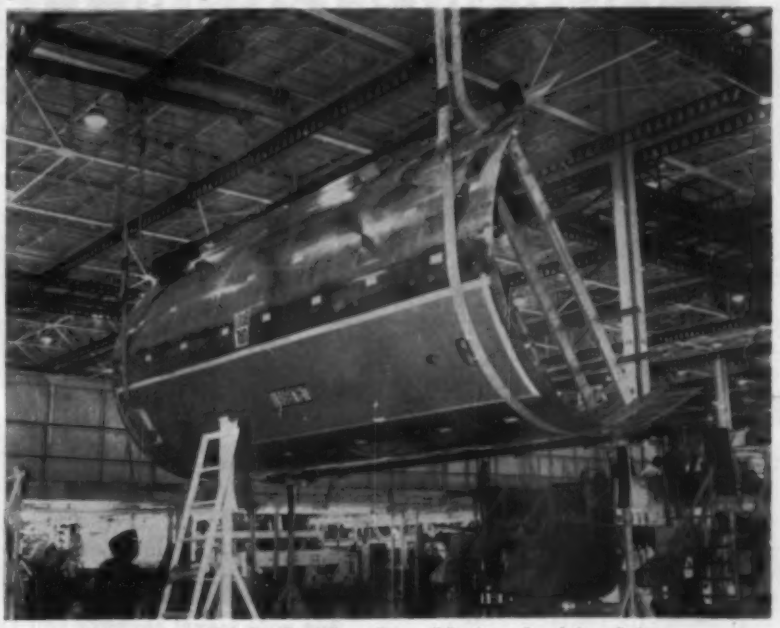
As an example, the company cites a study of generator units used by the Air Force on the KC-135. Three of these had a total of 150,192 flight hours and 55 failures, which was translated into 0.367 failures per 1,000 hr. of operation. In each case, repairs to this part and allied components amounted to $10,000. In comparison, an airline using four of the same generators on a 707 reported five failures in 18,016 component flight hours. Early application of the Boeing formula to the carrier's operational use results in the installation of manual disconnect attachments preventing further damage to allied parts and affording the airline a total saving of $50,000, according to Boeing.

This one change also brought the carrier's failure rate for this component up to 9,000 flight hours between failures.

Ground Service

In a similar manner, KC-135 information from the Air Force has enabled airlines to realize further savings in advanced planning for ground servicing on the 707. Comparing the advantages of fuel-air starters against electrical ground carts for the commercial jet, Boeing found the latter system would experience 10 failures out of every 1,000 starts while the air system would have 11, so that there was little difference between them for airline reliability.

However, in exploring the problem further, they estimated the self contained units would require four times as much maintenance and have the disadvantage of adding extra weight to the aircraft.



Boeing 720 Built for United Air Lines

First major assemblies on Boeing 707-720 intermediate range turbojet transport built for United Air Lines are under way at Boeing Airplane Co.'s Renton, Wash., plant. Fuselage section shown here is being moved from assembly jig. United has purchased seven additional Boeing 720s, raising total Boeing transport order to 18 (AW June 8, p, 38).

TWA Jets now serve:

NEW YORK · LOS ANGELES
CHICAGO · SAN FRANCISCO
WASHINGTON · BALTIMORE

TWA WORLD'S FASTEST AND LARGEST JETLINER
BOEING 707

See your travel agent or call TWA

TWA
TRANS WORLD AIRLINES

Airline Traffic—April, 1959

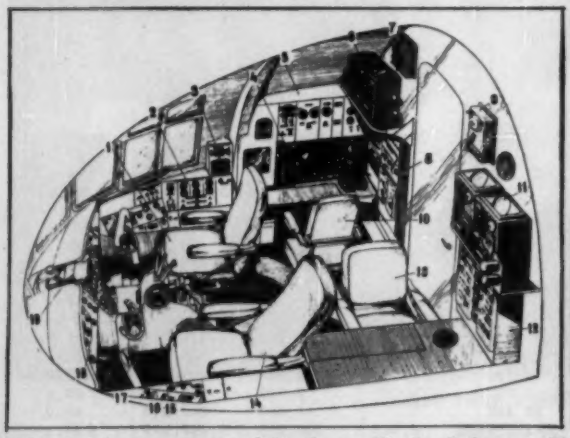
	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	645,651	445,974	70.6	1,856,795	803,358	7,913,864	53,443,349	60.1
Braniff	174,777	75,224	58.7	320,757	183,736	609,718	8,355,415	48.9
Capital	336,591	143,850	60.6	534,445	267,526	353,133	14,945,589	53.1
Continental	77,318	36,994	49.2	106,014	35,370	153,144	3,852,353	45.3
Delta	259,710	132,910	58.9	409,423	277,148	1,161,684	14,635,766	53.0
Eastern	707,899	394,161	53.19	984,245	486,671	1,324,018	40,793,195	42.74
National	160,419	103,535	56.9	324,291	68,111	602,000	11,018,099	45.1
Northeast	100,964	46,366	50.6	100,154	34,906	100,828	4,672,904	40.6
Northwest	142,342	105,801	51.9	521,040	245,375	1,318,589	12,245,938	45.4
Trans World	404,894	332,953	67.9	1,255,302	690,307	2,419,290	36,259,799	59.7
United	561,293	379,362	62.2	2,776,767	983,243	6,258,623	46,437,120	56.8
Western	118,780	60,801	57.5	268,454	87,547	305,543	6,490,382	49.6
INTERNATIONAL								
American	9,014	9,222	56.1	9,713	464	233,606	1,197,726	56.2
Braniff	3,371	6,221	45.7	16,705	.....	118,006	815,135	44.9
Caribbean Atlantic	29,625	2,026	86.5	1,662	.....	4,765	221,183	69.4
Delta	3,808	4,623	45.5	7,406	.....	43,543	563,535	40.7
Eastern	32,850	48,615	49.78	79,257	.....	134,604	5,037,909	46.65
Mackey	11,948	2,344	45.7	.....	169	2,327	255,174	45.6
National	7,166	5,247	56.3	8,382	4,658	33,013	602,558	48.5
Northwest	12,030	26,534	55.2	1,295,796	17,779	1,034,440	5,172,825	65.1
Pan American								
Alaska	2,546	2,667	40.4	20,527	.....	140,417	450,012	47.7
Atlantic	100,438	127,242	69.9	1,458,612	.....	2,637,607	17,482,312	63.6
Latin America	99,676	103,207	63.9	380,050	.....	4,315,281	14,838,797	64.9
Pacific	25,638	101,318	79.2	1,282,338	.....	2,178,266	14,068,885	71.5
Panagra	10,728	14,282	58.3	70,597	.....	535,128	2,174,195	63.1
Resort	.....	.....	.....	.....	.....	4,522,944	4,522,944	81.7
Trans-Caribbean*	.....	.....	.....	.....	.....	.....	.....	.....
Trans World	28,277	89,262	76.4	889,039	.....	1,869,551	11,977,281	73.8
UMCA	149	49	31.4	.....	.....	514	5,791	33.8
United	8,004	19,904	64.0	137,321	.....	98,146	2,270,868	62.8
Western	3,346	5,203	52.3	13,735	.....	21,645	587,873	55.8
LOCAL SERVICE								
Allegheny	42,489	7,326	46.2	11,777	22,381	25,157	738,334	44.0
Bonanza	19,216	4,841	54.5	5,759	2,454	8,291	479,895	57.6
Central	14,162	2,678	35.3	7,551	3,726	9,670	277,604	32.0
Frontier	23,416	5,800	38.9	23,294	9,846	59,265	650,351	45.7
Lake Central	18,603	2,974	43.6	4,526	15,486	.....	304,297	47.0
Mohawk	45,615	8,875	56.8	10,675	14,149	14,197	884,911	56.6
North Central	70,651	12,041	45.9	31,748	37,243	.....	1,226,504	46.4
Ozark	48,116	8,227	43.3	13,811	23,259	22,828	844,897	45.1
Pacific	35,142	7,903	53.2	13,020	5,483	8,021	780,282	51.2
Piedmont	40,607	8,317	47.0	17,316	11,608	14,362	840,667	47.4
Southern	21,886	3,919	39.4	9,745	9,794	13,105	409,926	39.9
Trans-Texas	20,954	4,961	40.6	16,359	8,905	30,363	531,220	41.6
West Coast	26,112	5,074	46.42	5,910	2,917	8,512	501,606	46.45
HAWAIIAN								
Aloha	17,090	2,318	55.4	1,437	.....	5,762	193,214	54.2
Hawaiian	34,982	5,162	60.3	4,390	.....	114,026	532,803	60.3
CARGO LINES								
AAXICO	.....	.....	.....	6,120	11,792	2,990,326	3,008,326	72.93
Aerovias Sud Americana	.....	.....	.....	.....	.....	609,693	609,693	82.7
Flying Tiger	3,721	17,459	100.0	36,140	56,739	11,875,506	13,714,274	89.7
Riddle								
Domestic	.....	.....	.....	7,045	21,775	3,934,357	3,963,177	75.7
Overseas	.....	.....	.....	.....	.....	635,169	635,169	69.0
Seaboard & Western	327	1,334	100.0	283,060	.....	2,219,386	2,641,590	44.0
Slick	4,081	24,220	98.04	.....	.....	.....	2,241,994	98.04
HELICOPTER LINES								
Chicago Helicopter	13,369	245	44.9	1,284	.....	.....	24,598	37.5
Los Angeles Airways	3,971	117.3	56.4	4,735	2,420	.....	18,398	61.8
New York Airways	8,579	165	45.2	1,872	1,371	589	19,622	46.4
ALASKA LINES								
Alaska Airlines	9,171	8,091	63.4	61,022	2,641	158,181	1,020,003	51.4
Alaska Coastal	3,805	409	55.0	4,171	.....	3,040	49,125	60.4
Cordova	928	178	46.6	4,226	.....	58,531	81,184	47.9
Ellis	4,370	275	58.7	1,705	.....	2,389	32,058	68.5
Northern Consolidated	1,694	518	33.0	38,469	.....	54,036	149,264	56.2
Pacific Northern	9,568	7,797	47.3	113,825	8,045	229,015	1,197,279	59.1
Reeve Aleutian	641	698	39.7	32,877	.....	143,294	252,664	56.2
Wien Alaska	2,637	733	22.7	44,464	.....	257,126	376,367	57.6

* Not available.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

Aeroflot, the Soviet state-owned airline, has started Il-18 turboprop transport service between Moscow and Adler on a three hour, nonstop schedule. Aircraft is shown at Adler as Mi-4 helicopter in Aeroflot markings (top) leaves for scheduled service between Adler and Sochi, on the Black Sea (AW Mar. 9, p. 161). At bottom, Il-18 undergoes a maintenance check; note truck used for towing.

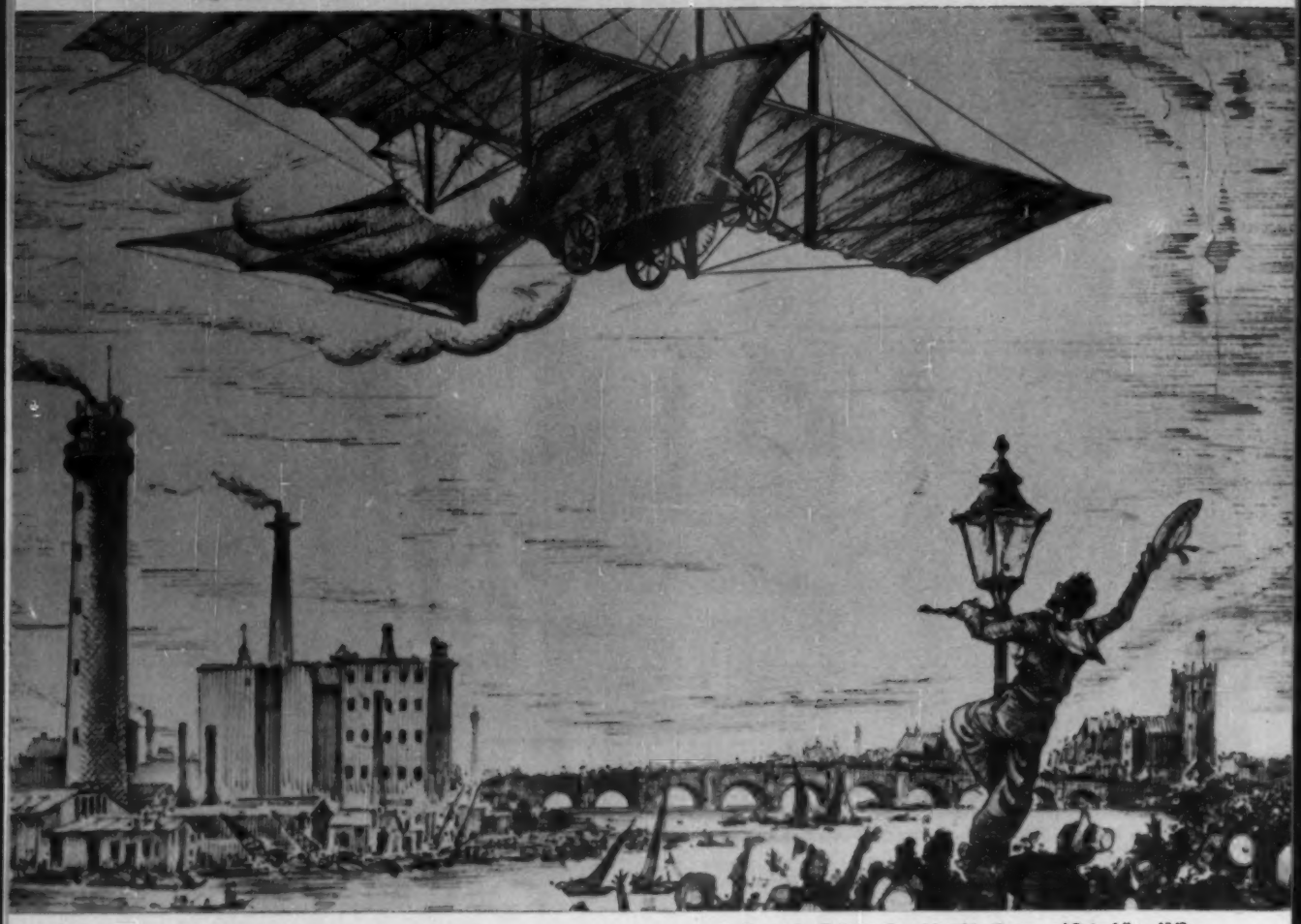
Aeroflot Begins Il-18 Service Between Moscow, Adler



Il-18 cockpit arrangement (left) shows: (1) Copilot's seat (2) deicer and oxygen controls (3) autopilot (4) radios (5) radio controls (6) transmitters (7) antenna units (8) electrical equipment controls (9) command antenna (10) radio operator seat (11) command transmitter (12) power supply distribution (13) navigator seat (14) pilot seat (15) central control panel (16) ILS instruments (17) nose gear steering (18) flight instruments (19) radar scope. Scope is not installed in cockpit at right.

Flaps down and right oleo strut low, Il-18 uses inboard engines to taxi to ramp at Moscow's Vnukovo Airport. Nose of another Il-18 is in foreground; note weather radar nose installation. Devices behind radome are antennas. Below, stewardess and agent check passenger tickets during loading. Ramp is hydraulic, self-propelled unit, indicates trend toward more modern Aeroflot ground handling equipment.

Propulsion through the ages . . .

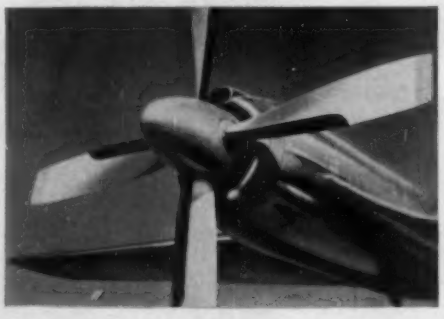


Steam propelled aircraft envisioned by Henson and Stringfellow, 1847

An astounding proposal : in 1847, William Samuel Henson and John Stringfellow collaborated on the design of the "Aeriel" and produced a model. A steam engine was designed to drive two propellers by means of cords from a large crankshaft pulley. Experiments in Gloucestershire continued seven weeks. Annoyed by irreverent crowds and heavy airs the aeronauts attempted night flight, only to be grounded by dew on the silken wings. More recently in Gloucestershire, where Rotol is located, Rotol designed, developed and produced the propellers for the first turbo-prop aircraft (1945). Since then, Rotol has supplied turbo-props to more than 100 airline and aircraft operators throughout the world who attest to Rotol reliability. Rotol propellers are standard equipment on the Vickers Viscount, Fairchild F-27, Grumman Gulfstream and Fairey Rotodyne.

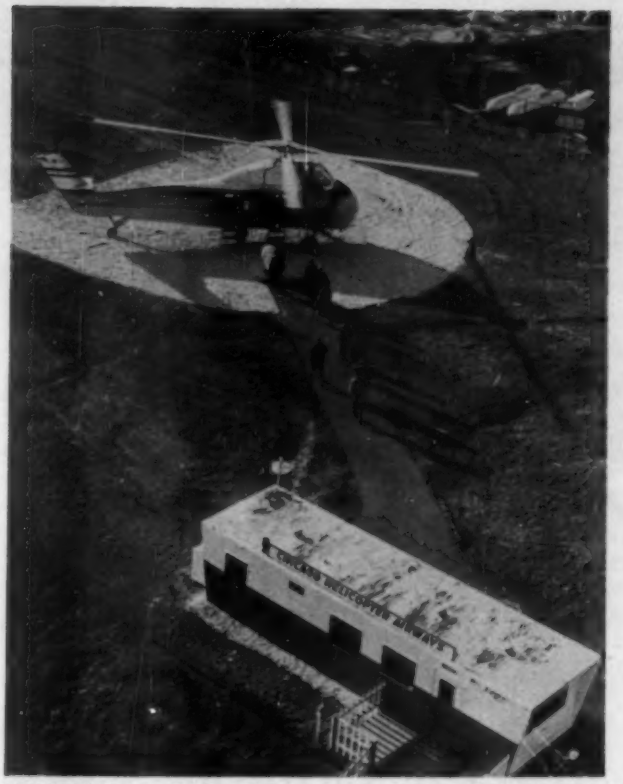
ROTOL

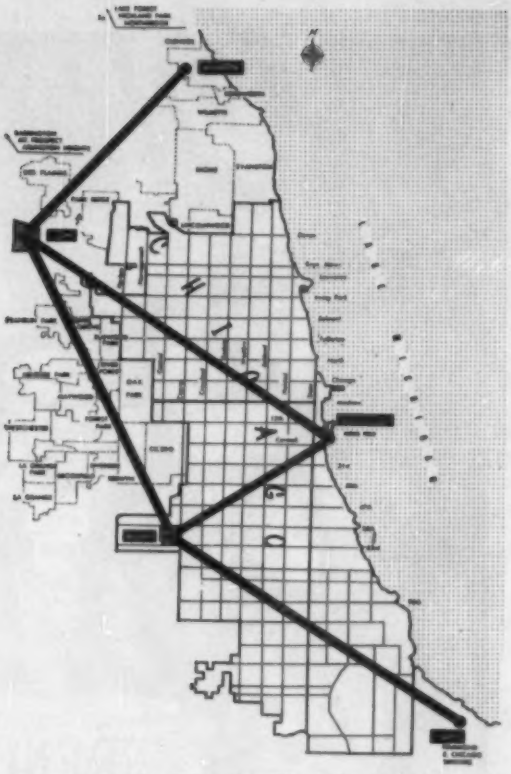
The world's most experienced manufacturers of turbo-propellers — over 6,000,000 hours of flying time.



Rotol Incorporated after-sales service throughout the United States provides immediate spare parts delivery, technical service on propeller operations and applications.

For information on Rotol products and after-sales service, call Rotol Incorporated, 409 Jefferson Davis Highway, Arlington 2, Virginia. Phone OTis 4-6290





ROTOR blades turning, a Chicago Helicopter Airways Sikorsky S-58 boards passengers at the Winnetka, Ill., heliport for flight to Chicago's airports or downtown. At right is the five-point passenger route; Winnetka, O'Hare, Midway, the Loop and Gary.

Chicago Helicopter Buys Turbine S-61s

Midway Airport, Chicago—Chicago Helicopter Airways is announcing today that it has signed an agreement with Sikorsky Aircraft Division of United Aircraft Corp. for the purchase of three turbine-powered S-61 helicopters.

The order, first predicted by AVIATION WEEK (AW June 1, p. 51), calls for delivery of the three-engine aircraft in early 1961. The 25-passenger helicopters were chosen by the Chicago carrier as the aircraft "keyed to CHA's future look" after long studies and surveys of equipment available in today's markets and on the drawing boards.

Primarily, the fleet, which may be increased to a total of five, is designed to absorb Chicago's rapidly expanding traffic record—a record that uncontestably establishes the company as the fastest growing airline in the U.S. A fleet of five S-61s will produce three and one-half times the number of seat miles the carrier obtains from its present fleet of five 12-passenger Sikorsky S-58 helicopters.

Once the S-61s are fully integrated into Chicago's inter-airport and suburban schedule pattern, the carrier will gradually phase out its S-58s to make the company an all-turbine-powered helicopter operator. The extra capacity of the S-61s not only will help it to cope with the rising traffic demand but will permit further route expansion in suburban areas and cut seat and ton mile costs of the operation.

Maintenance Plans

The S-61 is powered by three General Electric T58-6 gas turbine engines. Engine overhaul and maintenance plans have not been finally settled by CHA. It has been decided, however, that major overhaul of the engines will be handled by General Electric. The amount of maintenance work it will undertake will be determined after further negotiations between the two companies.

Chicago will do all airframe overhaul and maintenance and probably will handle all engine line maintenance. Company mechanics will be trained by General Electric and Sikorsky. A T-58-6 engine has been on display in the company's overhaul hangars here so that mechanics have had an initial opportunity to study it. Pilots will be checked out under Sikorsky's supervision.

Financial arrangements covering the purchase are still in the discussion stage between Sikorsky and Chicago.

Chicago Helicopter officials are confident that the introduction of the S-61s will pose no new problems but, conversely will improve operating efficiency —a factor that has contributed heavily to the company's record of achievement thus far.

For example, average speed of the S-58 has been hiked from an average 78 mph. in mid-1957 to 88 mph. in May to permit a substantial increase in daily scheduled miles. The S-61 will have a cruise speed of 150 mph.

C. W. Moore, executive vice president, told AVIATION WEEK that the average speed boost of the S-58s has been accomplished, not by accelerating throttle speed but by improving pilot proficiency, eliminating circuitous routings and working out more efficient air traffic control procedures in cooperation with Chicago tower controllers at Meigs, O'Hare and Midway, the three airports served by Chicago in its triangle service.

In this connection, John S. Gleason, Chicago Helicopter president, points to the airline's safety record as strong testimony to the "dependability of scheduled helicopter operations." CHA has operated four million miles over a period of 10 years without an accident

FRENCH AIRLINE LAUNCHES FIRST FAR EAST SERVICE!

CAPTAIN M. NOGUES COMPLETES FIRST SCHEDULED FLIGHT BETWEEN MARSEILLES, SAIGON!

Marseilles, France, February 15, 1931—Captain Maurice Noguès landed his tri-motor Fokker aircraft at La Ciota Airfield today after completing the first scheduled round-trip flight between Marseilles and Saigon, Indo-China. Captain Noguès' exploit marked the culmination of five years of exploratory flights along the route. The service is expected to speed mail, cargo and passengers between Paris

Maurice Nogues

FIRST IN INTERNATIONAL AIR TRAVEL! Since the very beginning of aviation history, men like Blériot, Bossoutrot and Noguès have led the way in international flight. Today Air France continues this tradition of leadership in air transport by offering the most non-stop flights both ways between New York and Paris and the fastest jet service in Europe and the Middle East. Next year Air France plans to cover the world's largest route network with one of the largest fleets of jet aircraft in the world.

AIR FRANCE

WORLD'S LARGEST AIRLINE / WORLD'S FIRST INTERNATIONAL AIR SERVICE

or passenger injury. Pilot six-month proficiency checks call for autorotation landings with a dead engine.

Despite the fact that CHA's operations are always under VFR conditions during the period from 6 a. m. to 11 p. m. when it conducts its scheduled service, the airline in April completed 95.9% of scheduled flights. It maintains a high on-time performance because its flight traffic patterns are divorced from fixed-wing traffic patterns and long hold periods are seldom experienced.

Traffic procedures permit CHA to cross runways in use at a 300 ft. altitude. In airport control zones, CHA maintains a 500 ft. altitude and generally conducts en route operations at 1,500 ft. Routes over Chicago vary in width from a quarter mile to a half mile.

Two minute turn-arounds have been made possible by efficient loading and unloading procedures. Rotors are not shut down at intermediate stops so that no time is lost in restarting engines.

The S-61 is designed to fit within CHA's operating policy. Space will be provided under seats to allow a more generous use of carry-on baggage than that now possible with the smaller S-58s. Overhead racks will be installed for hats and coats. Passenger door will open down into a stairway so that a loading ramp at airports will not be necessary.

Test Flights

The S-61, which is scheduled for test flights in mid-1960, has a flying boat hull construction (AW April 27, p. 50). The aircraft will be equipped with a rotorhead fairing and retractable landing gear. It will have a five-bladed main rotor and five-bladed tail rotor.

Operating efficiency of CHA extends beyond flight operations. For example, during the month of May, the airline carried a record 17,140 passengers. Bookings for these passengers were handled by a reservations crew of only eight persons—an average of more than 2,000 reservations per agent.

Such efficiency permits a crash implementation of extra sections to meet sudden demands for seats that often cannot be accurately anticipated as far in advance as a trunkline seat requirements can be planned. On May 8, the airline handled 800 passengers—a record for daily operations—through the introduction of extra sections at peak periods.

During one hour of the day, CHA filled 94 of the 96 seats offered on eight flights operated on the airport triangle route. Load factor for the day on the O'Hare-Midway route reached 85%. System load factor passed 60%.

The carrier recorded a load factor of 52% for the month of May, a sharp climb from the 39% load factor reached in March. CHA blocks off no load seats in figuring load factors and uses the total capacity of 12 seats on its S-58s in computing available seat miles. In addition, the recent load factor climb was accomplished in the face of an additional five round trips inaugurated on the airport triangle route in April. Four more round-trip flights will be added to the route in July.

Passenger traffic goal for the airline this year is 159,475 passengers, which, if realized, would represent a 40% increase over the 108,000 passengers carried last year. Moore has no doubts that his target will be reached. In fact, he now feels that he may have set his sights too low and that CHA may hit an all-time record of 165,000 passengers by the end of the year. The airline already is handling a traffic volume in excess of 48% over the number of passengers carried through May, 1958.

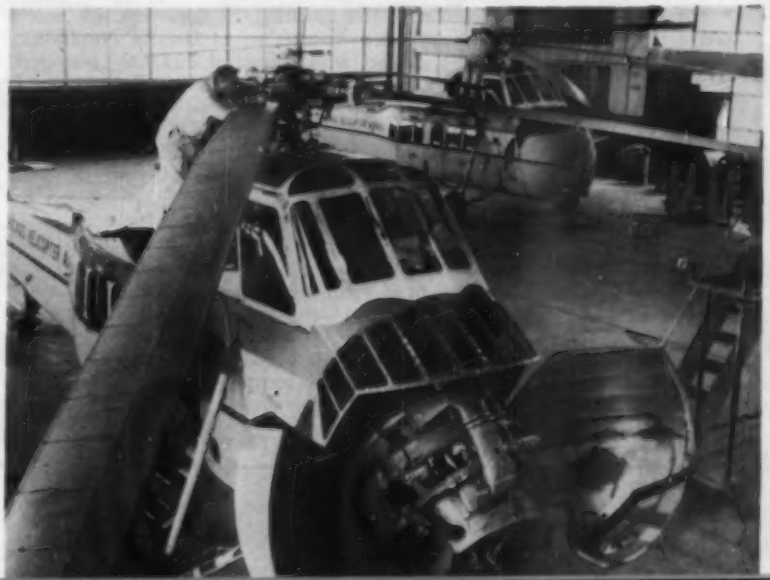
CHA operates seven daily flights to Winnetka, a wealthy suburb on Chicago's northern shore. Six flights daily are operated to the industrial community of Gary, Ind., south of Chicago. Main route, however, is the 42-mi. triangle route serving Meigs on the Loop shore, O'Hare–Chicago's jet airport–on the northwestern side and Midway on Chicago's southwestern side. CHA also operates three Bell 47G helicopters on a mail route serving 54 suburban communities.

Delay in Plans

The traffic demands of the triangle route have delayed the carrier from expanding its passenger service to suburban routes as originally planned. In addition, Moore points out that the airport route now offers the company its "biggest potential."

Civil Aeronautics Board is now investigating the feasibility of permitting trunklines to serve both O'Hare and Midway on the same flights following an

SIKORSKY S-58 helicopter is parked near Trans World Airlines Boeing 707 at O'Hare Field, above. Below, Chicago Helicopter Airways' mechanics perform S-58 maintenance.



AIRLINE OBSERVER

► Vickers Viscount 745D series aircraft are undergoing a close inspection on flap and aileron clearances under a new Federal Aviation Agency airworthiness directive. The agency says inadequate clearance between the end of No. 3 flap and the aileron has often resulted in an unsafe condition when flap fouled or contacted the inboard end of the aileron. Inspection was ordered completed no later than June 15. Wherever a gap of less than 0.25 in. is found to exist, the outboard end of No. 3 flap must be modified to provide proper clearance, a change considered mandatory by the British Air Registration Board, according to FAA.

► Flight Engineers International Assn. hopes to enlist the aid of the Society of Automotive Engineers' Committee on Cockpit Standardization to spell out the duties of flight engineers as a means of settling the current disagreement among the Air Line Pilots Assn., aircraft manufacturers and airlines. Crew complement issue has created confusion in cockpit seating, particularly with the placement of a third pilot on the crew of jet aircraft. The engineers union contends that efforts to seat the third pilot are displacing FEIA members from their own necessary cockpit positions at the expense of safety and economy of operation. Engineers will present SAE with a comprehensive survey of flight engineer duties highlighting statistics on both piston and turbine powered aircraft operational problems handled by FEIA members.

► Northwest Airline's single factor tariff for air cargo has tripled in scope since the first quarter of 1958. The air-truck plan, which now involves 12 trucking firms, is tapping new market areas in a 200-mi.-wide belt to either side of the carrier's routes. From an original service to 700 communities, the plan now covers 3,000 in 23 states.

► Russia has inaugurated its first regional jet passenger service in the Far East. Tu-104s were placed on the Vladivostok-Petropavlovsk, Kamchatka, route on May 15. Flight time is reportedly three hours as compared with five days by steamer.

► Federal Aviation Agency is collecting bids for a two-year weather study expected to produce a corrective formula for aviation weather problems for the next 15 years. Citing a need for greater accuracy imposed by such advances as planned supersonic transports, FAA's long range research is part of a joint program now being organized by the agency with the military services and the U.S. Weather Bureau. Particular emphasis will be placed upon detailed data collection to provide precise inputs for air traffic control computers now being installed by FAA. Computers have been commissioned for daily use at Idlewild International Airport and Washington National Airport. By late summer, additional systems will be installed in ARTC centers in Pittsburgh, Cleveland and Boston according to FAA.

► Passenger traffic slump on the Polish airline LOT last year was more severe than the carrier had anticipated when it raised fares in November, 1957. The government-owned airline, which handled 223,000 passengers in 1957, estimated it would board 60,000 fewer in 1958. But the total dropped by 88,000 to approximately 135,000 passengers.

► North Central Airlines credits its Convair 340 service for much of the 37% increase in revenue passengers carried last month. During the first full month of Convair operation, the airline carried 85,365 passengers to set a new monthly record for the local airline industry.

► Military Air Transport Service says it has the answer to the controversial problem of how much business to give commercial carriers without sacrificing its own operational strength. Lt. Gen. William H. Tunner, commander of MATS, points out that the Air Force moves 95% of its officers, airmen and their families overseas on military and commercial flights. If the other two services moved a comparable percentage by air, Gen. Tunner says it would increase MATS movements by almost 50% and also boost the volume of commercial airlift.

application for such service by Continental Air Lines. However, it is not likely that the service will be approved because of the traffic density implicit in such service.

As a result, CHA holds a strong position as the link between these two airports which are at least two hours apart by ground transportation during rush hours.

Increased traffic in O'Hare is reaping benefits for CHA, an indication that the helicopter line will be forced to continue its concentration in the triangle market. In April, the first full month of turbojet service at O'Hare, CHA carried about 2,000 passengers using the turbojet facilities. This total climbed to an estimated 5,000 passengers in May and, as more turbojet service is introduced during the year, the traffic demands made on CHA is expected to increase accordingly.

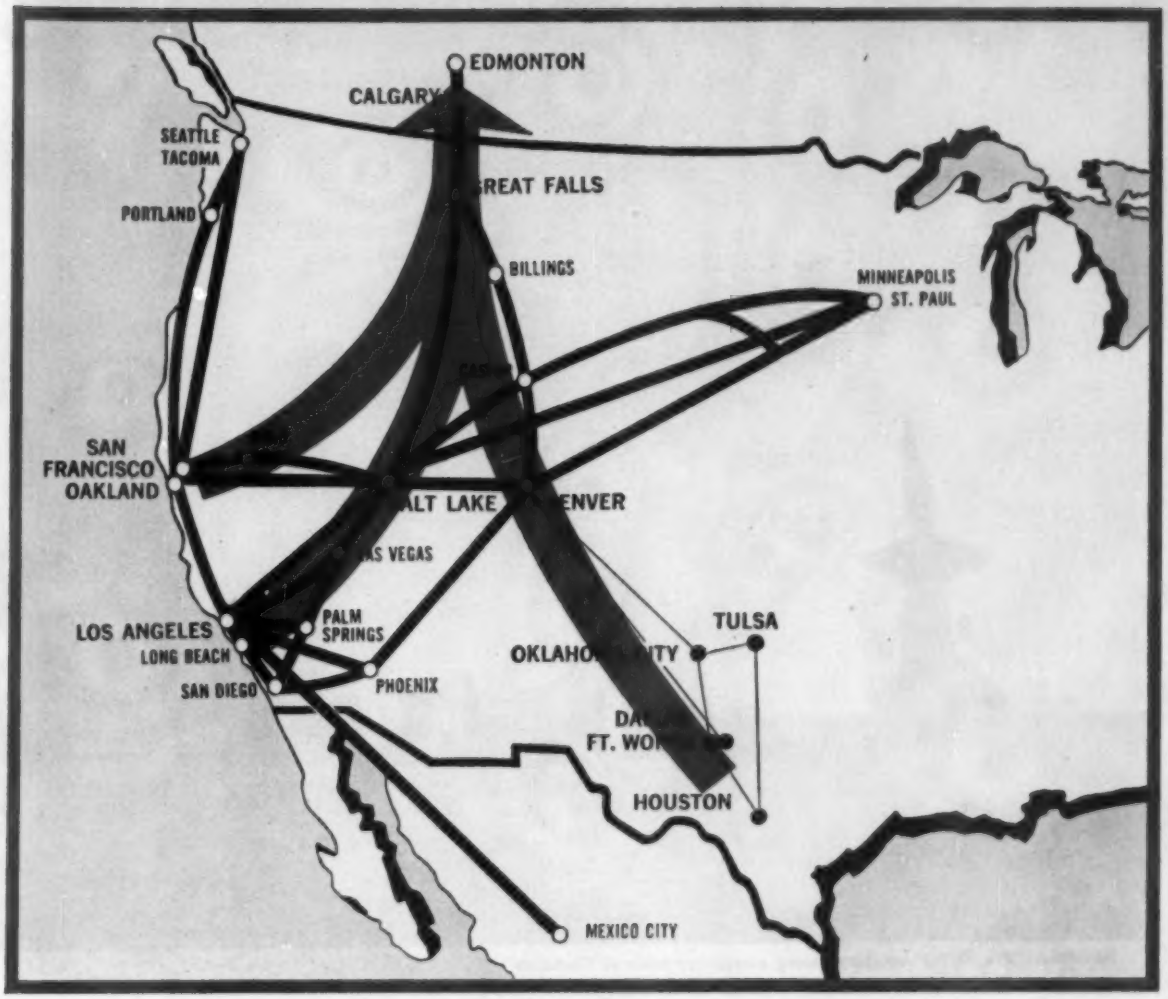
SHORTLINES

► **American Airlines,** with a major assist from the introduction of turbojet and turboprop aircraft, reports marked increases during May over comparable figures for last year. The carrier says its 8,250,000 freight ton mile figure establishes an industry record for the month and represents an increase of 11.5% over its May, 1958, figure. Other related figures are: revenue passenger miles, 470 million, up 11.6%; surface mail, 220,000 ton miles, up 14.6; air mail, 1,630,000 ton miles, up 3.4%; express, 800,000 ton miles, up 7.7%.

► **British Overseas Airways Corp.** is doubling the size of its downtown London terminal at a cost of $2.8 million. The eight-story, block-long building will be 90 ft. high and its length extended by 150 ft. Expansion will provide for the handling of some 1,000 passengers an hour. First stage of the work, including a restaurant, is scheduled to be completed within a year.

► **Hawaiian Airlines** has purchased an additional four Convair 340s, bringing the number of Convairs owned by the airline to eight. Purchase was made through William C. Wold Associates, and cost of acquisition and related equipment was approximately $1.4 million. Two of the aircraft came from KLM Royal Dutch Airlines, one from Ansett ANA Airways and the fourth from National Airlines.

► **Northwest Airlines** reports an April net income of $234,510, a gain of 192.2% over April, 1958. The carrier showed a 34% increase in passenger revenue at $7,735,504 and operating revenues of $9,681,920, for an increase of 31.5% over last year.



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WESTERN AIRLINES

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Security forbids publication of full details, but the following facts about Bloodhound can now be given:—

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DEFENCE

Power. The Bloodhound is powered by two Bristol Siddeley ramjets—jet engines with no moving parts. Ramjets ensure power and range flexibility, burn kerosene, are simple and safe to handle.

Homing System. Semi-active: i.e., ground crew directs radar beam on to target, which is reflected to a receiver in Bloodhound, ensures highest accuracy—regardless of range. Missiles may be fired, singly or in salvoes, using only one radar.

Airframe. Employs unique and advanced monoplane moving wing configuration—two advantages: quicker and more precise response, as well as greater accuracy of interception; superior at high altitudes. This configuration was selected at initial design stage to embody maximum development potential.

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and its future is not particularly bright. lel production lines or single-source total needs of Europe. French industry

FIRST Lockheed GC-130A drone director aircraft takes off from Robins AFB, Ga. Drone director launches and controls four Ryan Firebee targets above 30,000 ft. Drones are mounted on pylons under wing.

Lockheed Pushes European C-130 Plan

By David A. Anderton

Paris—Lockheed Aircraft Corp.'s Georgia Division is pushing hard to sell a new scheme for production of the Hercules C-130A turboprop transport in Europe.

The turboprop transport is featured here at the Salon International d'Aeronautique as part of the company's sales drive. Two C-130As, in service with the USAF's 322nd Troop Carrier Wing at Evreux, France, will demonstrate slow-speed and accelerated flight performance, plus maximum performance landings and takeoffs.

A large portion of the Lockheed static display is also devoted to the Hercules.

Specialist teams from the Marietta, Ga., Division, where Hercules was developed and is now in production for the USAF and other customers, have been making the rounds recently in Europe, AVIATION WEEK has learned. They have briefed governmental and military officials in many of the North Atlantic Treaty Organization countries.

Lockheed Proposal

Strongest arguments in the Lockheed proposal are these:

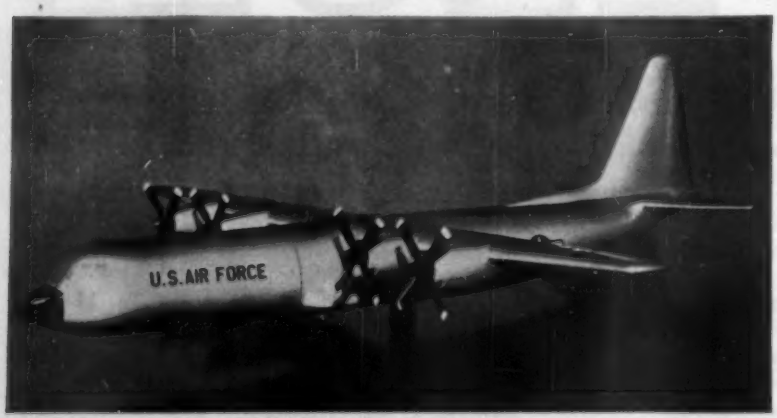
- **Logistics transport** could be in European service in two years' time after reaching agreements.
- **All production** will be European, with the exception of a few specialized parts such as castings or forgings.
- **Five years of development time** and $100 million could be saved, compared with development of a new transport by European industry, according to a Lockheed analysis.
- **Major savings** would also be realized compared with outright purchase of the airplane from the United States, if more than a couple of dozen were purchased.

In its present form, the Hercules meets or exceeds most known military airlift requirements originating in Europe.

Good Record

The plane has racked up a good record with the USAF all over the world, including airlifting during the Lebanon crisis. Its safety record has been outstanding. It has had fewer teething problems than any airplane ever accepted by the USAF for squadron use.

European needs for logistics transports are glaringly apparent. The basic fact is that the USAF simply will not be able to meet North Atlantic Treaty Organization airlift requirements in the event of war. Britain's Royal Air Force Transport Command is in a state which has been the subject of pained Parliamentary and press comment for years,



SUPER HERCULES version of the Lockheed C-130 turboprop transport is shown in model form and would be powered by Allison T61 turboprop engines developing 5,500 shp. each (AW April 20, p. 41). Stretched version is 280 in. longer (see p. 62).

and its future is not particularly bright. There would be little RAF strength available for NATO transportation if war came.

France's Nord Noratlas transport is the only relatively modern cargo carrier in service in Europe; deliveries are also being made to the Germans. But the bulk of Europe's airlift capability is made up of fleets of technologically obsolete Fairchild C-119s and Douglas C-47s, augmented by some local types with very limited performance.

Aircraft Estimate

Most European logistics experts estimate the minimum need for NATO at about 200 aircraft in the Hercules category, with 300 units mentioned as a desirable number. France would need the bulk of these with Germany and Italy coming in for second-largest batches.

Lockheed is moving into an area where there is already a large, if nebulous, European effort. The American company will have to fight both politically and technically for orders.

France and Germany have been operating, with Italian interest, on mutual development of a logistics transport, a twin-engined design with a gross weight on the order of 90,000 lb. Design work is believed to be under way by now at Weser Flugzeugbau in Bremen. Rolls-Royce Tyne turboprop engines have been specified as the powerplant.

Technical experts who are neutral in this matter have criticized the Weser design as being an attempt to build a twin-engined Hercules 10 years later. They point out that even with the most optimistic train of events, the plane could not possibly be in squadron service in less than five years, and that more likely the time cycle would be six to eight years. By that time, they argue, the design would be obsolescent.

National Problem

Major problem dogging earlier cooperative schemes for European production has been a nationalistic one. Each country wants to get its rightful share of the total order, even if it means setting up parallel production lines at greatly increased unit costs.

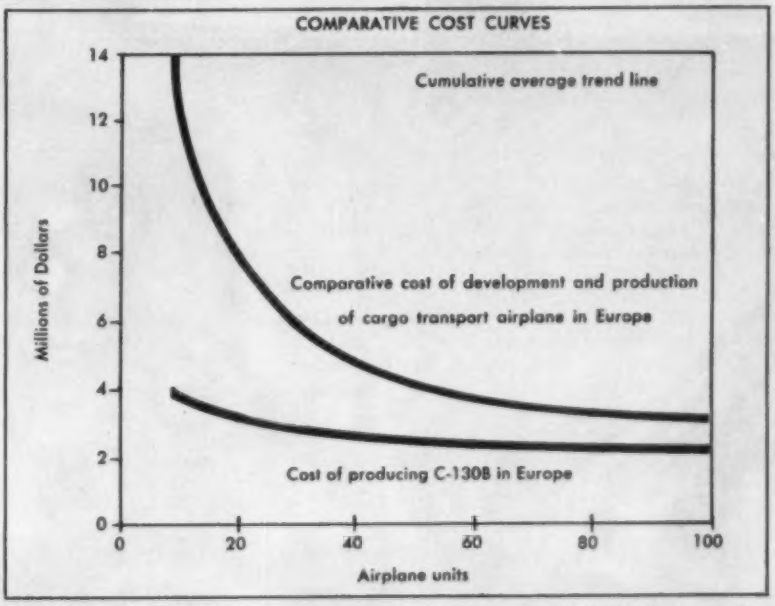
One classic example was the off-shore procurement program for the Hawker Hunter. The plane was in full production in Britain, but parallel production lines were set up in both Holland and Belgium. Unit cost figures have never been released, but it is obvious that the Belgian and Dutch Hunters cost more than those delivered to the Royal Air Force.

Production of NATO's lightweight strike fighter was planned as a cooperative venture; each country adopting the plane would share the building. Whether the planners envisioned parallel production lines or single-source production with foreign subcontracting is not known. Now, both plans have been combined, and Fiat G.91s are being built in Italy for the Italians, other customers and the Germans, while the Germans are setting up their own production for the plane.

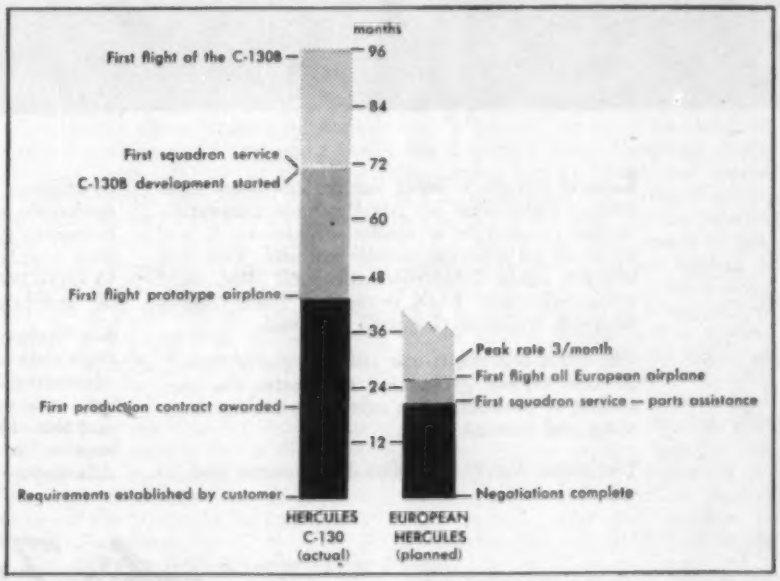
In contrast, production of the European Hercules is tied to the actual requirements of any particular country for the plane.

Thus, if France needed 100 airplanes, or about one-third of the estimated total needs of Europe, French industry would get one-third of the job. It might be center section fuselage construction and final assembly, which now totals about 36% of the man-hours effort on the Hercules. But the French would do that job for the entire run of 300 airplanes, and not just for the 100 they needed.

This would make the unit cost of the component the lowest possible, because it would be spread over the entire production run of 300 airplanes. This is obviously cheaper than letting the



LOCKHEED chart projects comparisons of costs to produce the C-130 in Europe against cost of development and production of a cargo transport, also in Europe.



EUROPEAN-BUILT Hercules could reach a peak production rate of three per month within a 28-month period after completion of negotiations, according to the company.

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French build 100 complete airplanes, letting some other country build 50 and a third build 25.

Lockheed-Marietta engineers have divided the European Hercules into seven basic packages for production. This breakdown of packages turns out to have two characteristics. First, package "value" varies between about 5% and 36% of the total man-hour effort. If a country has a small industry and a small requirement, it gets a small package.

Second, the work to be done on a package may be simple standard airframe construction, such as that needed for the empennage, or sophisticated machine work, such as that needed to produce the engines or the wing center section. If a country has a specialty in machine work, it gets the engine package.

Price Advantage

With few exceptions, all of the components of the European Hercules can be built by European industry as it now stands. There might be a price advantage in getting certain forgings, castings, or integrally stiffened panels from the Lockheed line, where costs are far down the learning curve. This is a production detail that could be easily worked out in agreements.

Time saving is justified by comparing the C-130 development program with that of the proposed European Hercules. The first prototype C-130 flew about 43 months after the requirements were established. First squadron entered service almost 72 months, or six years, after the requirements.

The first flight of an all-European airplane could be made about 26 months after completion of negotiations. The first squadron could be in European service in about 20 months after negotiations were completed, assuming that part of the agreement would include parts assistance by Lockheed to the European industry. This early assistance would be quickly phased out as the European lines built up to a typical rate of three per month at about 28 months after the completion of negotiations.

Time Cycle

Nobody is going to beat that kind of a development time cycle. If any manufacturer in the world started tomorrow to design a new military transport, the plane would not be in squadron service for at least five years. Technical observers of European industry are inclined to raise the sights even more and say eight years.

The development programs for their C-130A and C-130B models required more than 27 million man-hours of engineering and tooling time. These astronomical figures can not be matched by individual European industries. Even a cooperative industry, such as the idealistic planners of the Common Market have dreamed about, would barely have the capacity to meet that requirement alone, to say nothing of handling the other projects now either in the works or planned.

TWO Lockheed C-130 turboprop transports manned by specially-trained crews from 61st Troop Carrier Squadron, Sewart AFB, Tenn., land on Greenland ice cap with heavy construction equipment for an extended Distant Early Warning (DEW) Line project. Aircraft are equipped with skis. In foreground is Maj. Roy Gabrielson, squadron operations officer.

If European cooperative production were accepted, there would be employment for about 8,000 persons over a normal production run for about 100 airplanes.

American Scale

On an American scale, this is relatively small; but by European standards, this is larger than the entire Italian aircraft industry, or almost as large as the entire German aircraft industry. This is substantial employment for Europe, and certainly a heavy factor to weigh in any decision.

Lockheed's scheme is not a rigid one. There is nothing to prevent one country alone from tackling the entire job of license production except the very practical factor that only two European countries have industrial capacity in plants and personnel to do the job.

The company has also proposed the installation of Rolls-Royce Tyne turboprop engines replacing the standard Allison T56 engines now in the USAF airplanes.

The advantages of a Tyne-powered Hercules are apparent for those countries with the need to buy in the pound sterling area, and might be the reasons for weighing a prospective decision in favor of the American airframe with British powerplants.

The fact that Rolls-Royce is willing to license production of its engine units —presumably the Tyne would be no exception—also lends weight to the arguments.

There are counter-arguments to the positive ones that Lockheed puts forward. One European NATO nation regards the Hercules as entirely too big, and is thinking in terms of a smaller tactical transport. Perhaps the best answer to this is that nobody connected with military transport has ever heard of a case where there was too much capacity in an airplane. Technically, the Hercules is capable of meeting that country's requirements for takeoff and landing on unprepared strips in a tactical situation, and then exceeding by a wide margin all other requirements.

European Engineers

Another argument is that the Lockheed proposal doesn't take into account the engineers now in European industry. What will be in it for them, to stimulate their design thinking? Nothing much, says Lockheed, and maybe it's an advantage. The brilliant design teams of Europe can then concentrate on the design and development of new airplanes, second-generation fighters or defensive missiles, instead of wasting their time duplicating or trying to better an existing design that is already more than adequate to the needs of Europe for the next decade.

But the airplanes are expensive, runs another argument. Their absolute cost is high. But no airplane comes cheap nowadays, and any native European development will cost more on a unit basis anyway. The sole question is whether or not the airlift capacity is needed.

If it is, says the company, the European Hercules is the answer.

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Chart prepared by National Research to indicate vacuum requirements for space simulation. Data taken from International Geophysical Year Reports. Copyright 1958 by National Research Corp.

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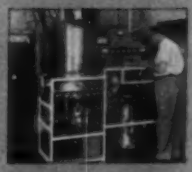

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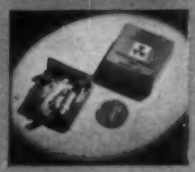

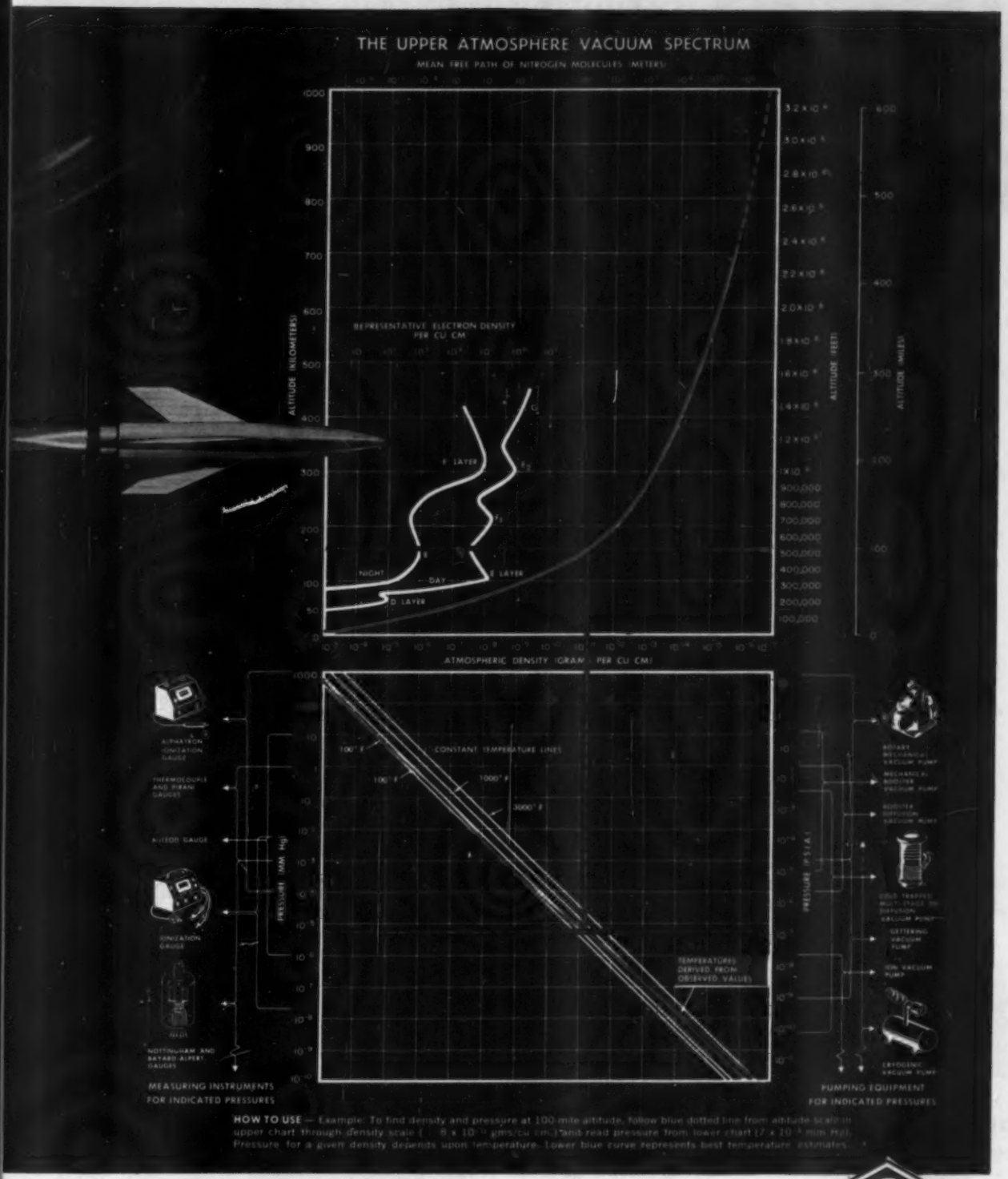
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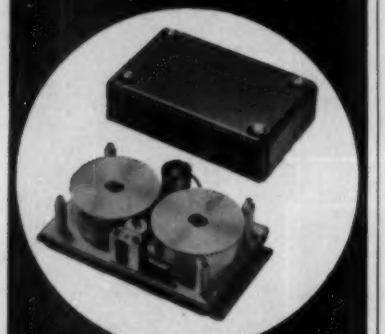

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C-130 Hercules Lengthened To Increase Long-Range Missions

By J. S. Butz, Jr.

Marietta, Ga.—Lockheed is offering the military services and commercial operators a stretched version of its C-130 Hercules transport designed to cross the Pacific nonstop with 32,000 lb. of cargo at 360 to 370 mph. cruise speed or the Atlantic with 50,000 lb. of freight at better than 410 mph.

The Allison T61-powered, stretched Hercules is a major talking point on the turboprop side of the current debate in Congress and the Pentagon concerning the relative merits of turbojet and turboprop transports. One of the most advanced turboprops in consideration today, the new Lockheed transport has the small field capability of the C-130 and can operate out of 80% of the military airfields in the free world, according to its designers. Its operating costs are lower than those of the original Hercules, Lockheed says, dipping below four cents per ton-mile when carrying a maximum load of 78,000 lb. over a 1,500-mi. route.

These two qualities—small field capability and low operating costs—are among the turboprop's strong points when they are compared with the faster turbojet transports which require runways of about two miles in length.

Another favorable point concerning the stretched Hercules is the palletized loading system developed for the earlier model. Loading and unloading times for the maximum cargo load when using this system are scheduled to be less than 20 min. Complete time on the ground during turnaround can be about 30 min., during good weather adding greatly to the aircraft's utilization. This loading system employs nine pallets 7 ft. long onto which the cargo is preloaded on the ground.

The pallets are then placed on a flatbed truck with rollers and pulled into the truck-level cargo compartment of the aircraft as a single load. This process takes a few minutes, and the pallets are automatically locked to the cargo floor, eliminating the necessity for a lengthy tiedown.

Lockheed is designing the new Hercules to the specifications of the Federal Aviation Agency as well as the military services in hopes that it will be available for commercial use as soon as the first aircraft is rolled out. This was not done with the C-130. First deliveries could take place in fall of 1961 under present Lockheed plans.

External design of the stretched Hercules is very similar to that of the original C-130. Two hundred and eighty inches were added to the fuselage, 120 in. ahead of the wing and 160 in. aft of the wing. It will be possible to use C-130 tooling for the construction of the new stretched version.

The original tail can be retained because it has been moved aft and no more tail area is required. Major portion of the outer wing panels are the same on both aircraft as is the nose section and part of the aft fuselage. Modified C-130 tooling is used for most of the aft fuselage and a small portion of the outer wing. Completely new tooling is needed for the wing between the two inboard engines, for the nacelles and for a small portion of the empennage.

Landing gear for the new aircraft will have to be new to accommodate its maximum takeoff weight of 204,170 lb. and maximum landing weight of 187,135 lb. The main gear will be of the same basic eight-wheel design used on the C-130, and the nose gear will have dual wheels.

Wing area was increased on the new aircraft, and it was sized so that there would be enough fuel for the Pacific mission and give a minimum takeoff weight for the Atlantic mission. Only redesign of the outer surfaces of the aircraft from an aerodynamic standpoint was around the upswept aft end of the fuselage. This was refaired to get a lower drag at cruise.

Only major structural redesign was the relocation of the pressure seal on the aft end of the cargo compartment to ease the load on the full pressurization system. The seal was formerly on the larger outer doors on the cargo section. Now a dome shaped pressure bulkhead is placed inside at the end of the large tubular cargo compartment inside of the outer doors.

Flight handling characteristics of the new aircraft will be almost exactly the same as those of the C-130 according to Lockheed. The new aircraft will have Hercules acceleration characteristics since it was possible to keep about the same thrust-to-weight ratio on both aircraft.

The Allison T61 engines will deliver more than 5,000 hp. each. It is hoped that an improved version of the engine with water alcohol injection will lower the maximum takeoff distance over a 50 ft. obstacle to about 3,900 ft. Takeoff distances with the original Allisons will vary with the aircraft's loading and mission from about 5,100 ft. to around 4,500 ft. Rough field performance of the stretched Hercules will be similar to the original model.

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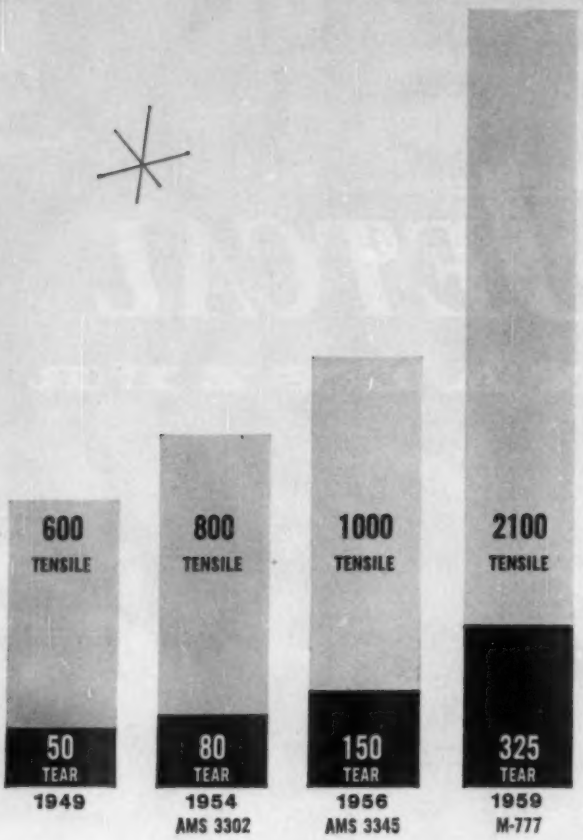
M-777 doubles many of the original physical properties of AMS 3345. It is unaffected by time, weather, sunlight or ozone — remains flexible at −105°F — resists heat up to 500°F — and has good electrical insulation qualities. Typical properties are listed below:

M-777 can now be specified for extrusions, moldings, extruded and spliced parts, or in combination with metals, reinforcing fabrics or with Teflon* bonded to the surface.



PHYSICAL PROPERTIES				
	As Received Properties	Dry Heat Resistance Aged 70 hours/400°F	Compression Set 70 hrs/300°F Percent of original deflection	Low Temperature Flexibility
M-777	Durometer Shore A 50 Tensile Strength, psi 2100 Elongation, % 600 Tear Strength, psi 325	Durometer Change − 8 Tensile Change − 20 Elongation Change − 20	45	−105°F
AMS-3345	Durometer Shore A 50 ± 5 Tensile Strength, psi 1000 Elongation % 500 Tear Strength, psi 150	Durometer Change 0 to + 20 Tensile Change − 50 Elongation Change − 40	73	−105°F

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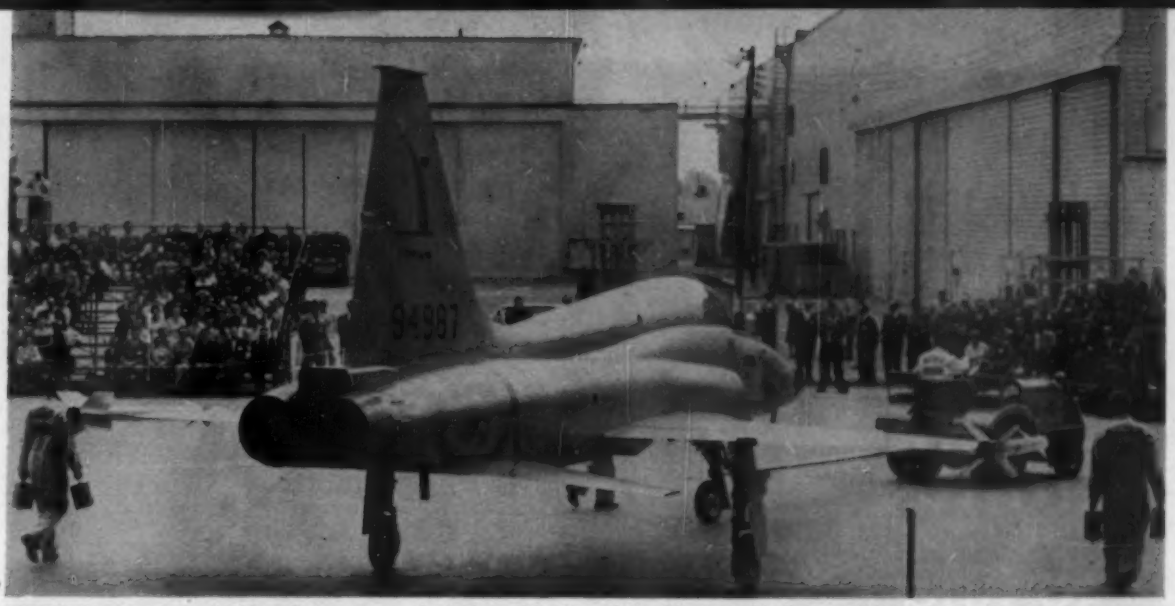


FUSELAGE PINCH and double tailpipes are emphasized in this view of the Northrop N-156F jet fighter at its rollout.

N-156F Embodies Frontal Attack Concept

By Richard Sweeney

Hawthorne, Calif.—Projected capabilities of air-to-air missiles to mount effective forward hemisphere attacks are basic tenets of N-156F weapon system recently rolled out by the Norair Division of Northrop Corp. (AW June 8, p. 29).

Designed for production and operation by NATO and SEATO nations, many of whose borders form what would be the "front line" in case of an attack, Norair bears down on these points of small, lightweight, twin-engine, Mach 1.5 aircraft in sales negotiations:

• **Starting from an early warning** radar pickup, through scramble of fighters, climb and intercept for a forward hemisphere attack by missiles, the N-156F allows an enemy intruder to go only about five miles farther than would a Mach 2 airplane, all other conditions being equal, according to Norair calculations. Detection was figured at 160 mi. from border, and attacker speed was more than Mach 0.9.

• **Using forward hemisphere** attack, the N-156F would stay below the enemy, allowing the missile to make the climb to intercept, saving time and fuel for additional combat, while making use of the quadrant which gives best return to both infrared and radar fire control systems.

• **Twin-engine reliability** and safety, no small matter in the day-to-day operations of an air force. Separate and dual systems in the aircraft keep one engine failure from being catastrophic.

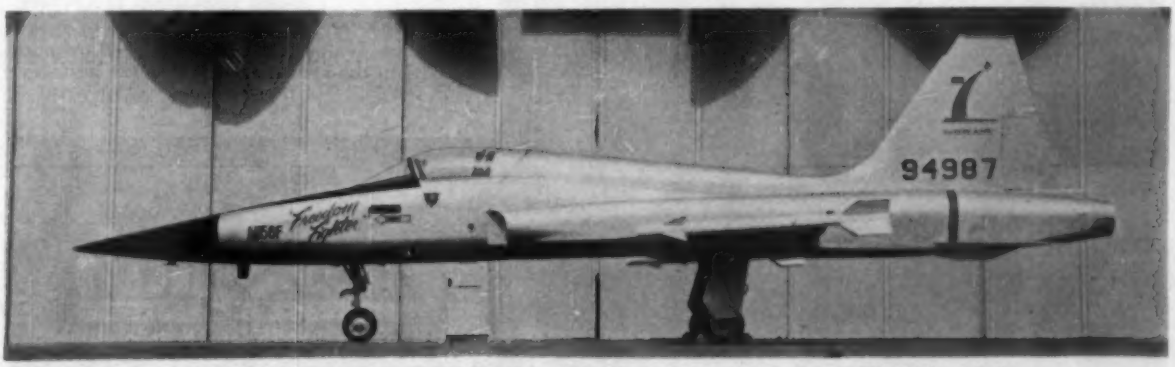
• **Starting from base of** relatively light and simple airframe and powerplants, N-156F can accommodate very sophisticated fire control systems and wide variety of external stores should the customer be able to maintain and operate the airplane in these configurations. In addition, the basic airframe-powerplant still is smaller, less costly and intricate to build, allowing the customer to get "more for his money."

• **Advance to Mach 2** speed capability is expected with engine improvements now in development.

Performance calculated for N-156F, which Norair used in comparing the plane with its competitors and in war gaming exercises, indicates an initial climb rate approximating 28,000 fpm. at sea level and corresponding drop with altitude, yielding an over-all time-to-climb to operational to launch missile from lower forward hemisphere attack, of about 2 min. from takeoff.

Range, figured on the basis of no external fuel, supersonic flight from time of reaching attack altitude until attack completed and subsonic cruise home, approximates 180 mi.

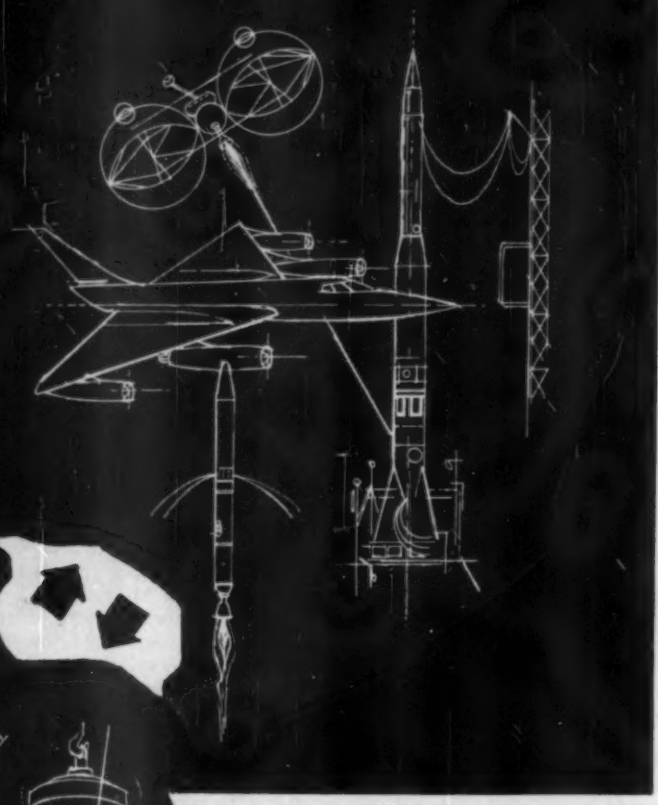
This range would be extended considerably if the normal pattern was

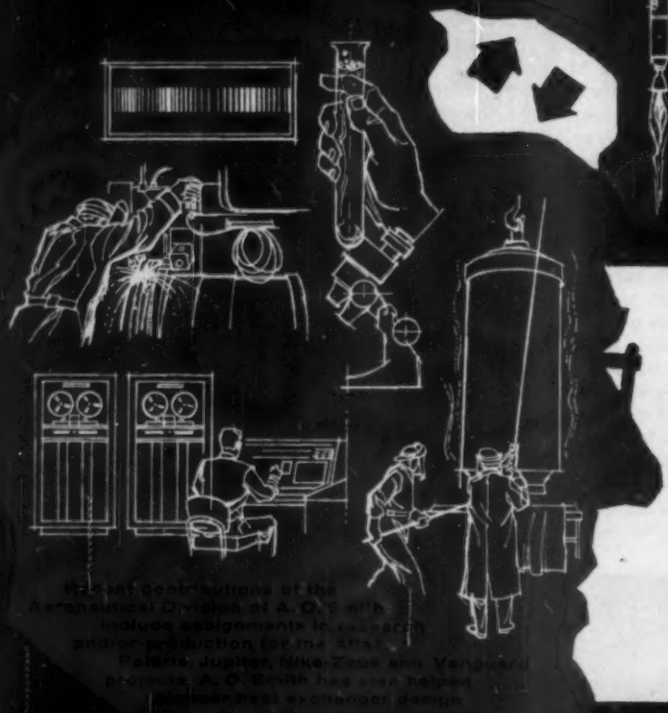


FIGHTER version of the T-38 Talon trainer, the N-156F is 43 ft. 11 in. long and is equipped with Sidewinder missiles.

meeting of minds

to find the means...





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DESIGNATED "Freedom Fighter," the Northrop N-156F will be delivered to USAF squadrons in March, 1961. Aircraft is planned for foreign production under license agreements.

followed of maximum effort climb, high subsonic cruise to intercept point after altitude is reached, than an attack initiated at Mach 1.4, the N-156F attack design speed. Missiles can be, of course, launched at any speed up to maximum; however, they are mounted with a 2½ deg. nose-down attitude in relation to fuselage reference line, to achieve the optimum angle for launch at design speed.

Starting from Mach 0.9 cruise, the N-156F can accelerate to its 1.4 Mach number in about 3 min., the company says.

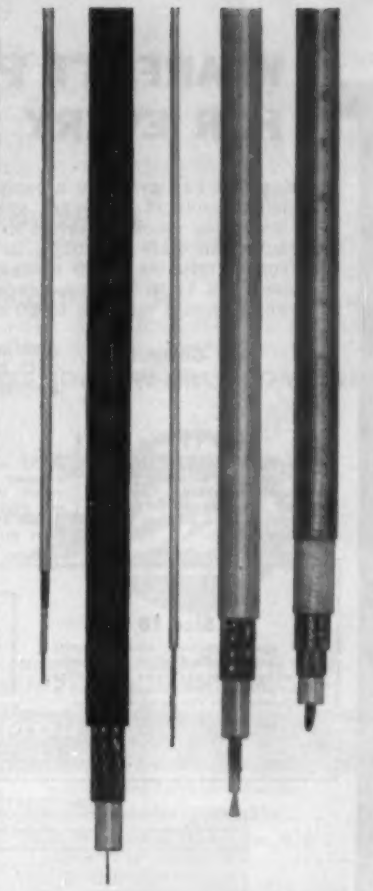
Offered basically at a maximum takeoff gross weight of 12,130 lb. with 600 gal. of internal fuel, Sidewinder type air-to-air missiles and the minimum required fire control system, N-156F can grow considerably.

An alternate configuration would have a takeoff gross weight of 15,000 lb., with 3,380 lb. (600 gal.) internal fuel, 1,950 lb. external fuel (two 150-gal. tanks), and 620 lb. of air-to-air missiles—one on each wingtip, two on a centerline belly rack, Sidewinder type.

As a strike-reconnaissance aircraft, with a takeoff gross weight of 16,230 lb., the fighter would carry one 2,000 lb. bomb on a belly centerline rack, one 160-gal. (975 lb.) external fuel tank on a wing pylon, while the opposite wing pylon would carry a 600 lb. photo-reconnaissance pod.

Maintenance projected for the N-156F is pegged at 21 man-hours per flight hour, according to Norair, as opposed to the two Mach 2 fighters ("X" and "Y") with which the fighter was compared on paper. Airplane X was rated at 46 hr./hr., while Y was rated at 43 hr./hr. Figures on X and Y were obtained, Norair said, from official tabulations. Norair declared the N-156F figure included all maintenance short of depot.

A large measure of maintainability of the N-156F is due, Norair says, to the use of the "service center" concept, plus an installation whereby accessories are not mounted on the engine but are coupled to it through a drive shaft and gear box, enabling accessories to be changed without removing the engine,



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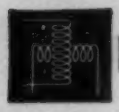

Kearfott has available a complete line of precision resolvers for every system application. Computing resolvers range in functional accuracy from 0.1% to .005%, in bridge accuracy from 5 minutes to 20 seconds of arc and in size from 11 to 25. Non-compensated resolvers range from 5 minutes to 20 seconds of arc in accuracy, from 8 to 25 in size.
All Kearfott resolvers feature stainless housing, shafts and bearings and corrosion-resistant lamination materials for maximum environmental resistance. Optional designs available for operation at 200°C and in environment of 2000 cps vibration at 30 g's.

Computing Resolvers

Available with integral compensating windings. Can be provided with trimming networks to match existing isolation amplifiers or Kearfott-designed transistorized amplifiers.

Size 11

For applications where size and good functional accuracy are of paramount importance. Functional accuracy as good as 0.1% and bridge errors of 3 minutes of arc are in production.

Size 15

A 2:1 improvement in functional accuracy obtained in this configuration. Unit tabulated is the direct equivalent of standard Navy BuOrd Mark 4 Mod 3 and contains necessary trimming network for standard buffer amplifiers. Transformation ratio is 1.000 ± .0001, phase shift 0° ± 1 minute. Functional accuracy of .05% and bridge error of 3 minutes of arc are standard.

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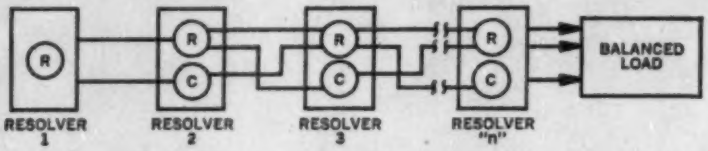
For applications demanding the highest order of accuracy. Close attention has been paid to design parameters.

Size 18

A special resolver which permits a unique cascading of these units without the necessity for buffer amplifiers. Typical application is illustrated in following cascade:



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COMPENSATED RESOLVERS FOR PRECISE COMPUTER APPLICATIONS

SIZE	11		15	18	25
PART NUMBER	R980-01	R980-41	T980-51	V980-004	425506-1
Excitation Volts–(Max.)	60	60	26	26	115
Excitation Volts (Test)	10	10	15	13	25
Frequency–(cps)	400	400	400	400	400
Primary Impedance	629 + j2510	450 + j2200	220 + j1000	3000 + j (0 ± 40)	1630 /78.5°
Secondary Impedance	695 + j2790	500 + j2200	240 + j1100	3000 + j (0 ± 40)	1620 /80°
Transformation Ratio (Primary to Secondary)	.980	.980	.980	.775	.980
Transformation Ratio (Compensator to Rotor)	.985	.985	.950	.775	.985
Phase Shift (Lead)	8.5°	7.5°	8.5°	0° ± 10'	2.1°
Fundamental Null (MV)	15	15	8	15	15
Bridge Error From E.Z. (Max.) Primary	*7 mins. Stator	*5 mins. Stator	*5 mins. Stator	3 mins. Stator	0.7 mins. Stator

*Also available 3 mins. from E.Z.

Non-Compensated Resolvers

Basically for application in precise data transmission systems. These synchro resolvers permit system designer to achieve system errors of better than 1 minute of arc without using 2-speed servos and elaborate electronics. By proper impedance matches up to 64 resolver control transformers can also operate from one resolver transmitter.

Size 11

Where size is important. These units have a maximum unit error of 3 minutes of arc.

Size 25

Where highest accuracy is required. These units have a maximum error as low as 20 seconds of arc.

NON-COMPENSATED RESOLVERS FOR PRECISE DATA TRANSMISSION

	SIZE 11			SIZE 25		
Type Resolver	Transmitter	Differential	Control Transformer	Transmitter	Differential	Control Transformer
Part Number	R982-004	R982-002	R982-012	Z5161-001	Z5191-001	Z5151-003
Excitation Volts (Max.)	26	11.8	11.8	115	90	90
Frequency (cps)	400	400	400	400	400	400
Primary Impedance	170 /77°	95 /80.2°	2000 /80°	400 /82°	800 /80°	8500 /82°
Secondary Impedance	42 /80.5°	110 /75.7°	8000 /76°	260 /82°	900 /80°	14000 /82°
Transformation Ratio	.454	1.000	1.906	.7826	1.000	1.278
Max. Error from E.Z. Primary	3 mins. Rotor	3 mins. Stator	3 mins. Stator	20 seconds Rotor	20 seconds Stator	20 seconds Stator

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or engine to be changed without touching accessories.

When questioned concerning statistics on delays in takeoff resulting from one engine malfunctioning on a two-engine plane, a Norair spokesman cited the record of the F-89 in this respect, statistics on which indicate a very low rate of such incidents.

For operational employment, N-156F has provisions for using zero launch rocket bottles which would be very close to those used on the USAF-Martin Matador, since the two machines are close in takeoff gross weight. Additionally, provisions have been made for incorporation of arrested landing equipment which would utilize the water squeezer type arrester. Coupled with leading edge flaps for lower landing speed, plus drogue parachute, Norair sees an airplane operable from a wide variety of sites.

N-156F was intended to use a cartridge starter, but since none was designed which satisfied Norair in the time period when it was needed, conventional outside air source is required to start one engine. However, at time of deliveries, Norair says it hopes desired start equipment will be available and installed as standard equipment.

Flight Tests

Forecasting expected trends in N-156F flight test development program, Norair indicated that if T-38 experience holds true, the airplane will progress through the company's specified flight test program unusually clean.

Norair said that as of the day the N-156F was rolled out, the T-38 had accumulated 18 hr. flight time in 21 flights. Of these, the company declared, the last eight were made without one complaint about the airplane itself. Additionally, Norair indicated that on the day the T-38 made its first flight, it was turned around and ready to make a second flight the same day, but was prevented by circumstances unrelated to the airplane.

Currently the T-38 is flying with two General Electric J85-1 engines which are essentially prototype powerplants. They have seven compressor stages, two main bearings and develop about 2,100 lb. thrust. Production engines will have eight compressor stages, three main bearings, will deliver 2,500 lb. thrust and will have afterburners as well, for a total thrust of more than 7,000 lb. The first of these engines will be delivered to Norair about September.

The T-38, so far in its flight test program, has reached Mach 1.04 by diving to speed, then leveling out. The company says this speed was sustained for a considerable period in view of available thrust. The airplane is cleared to Mach 1.1 as far as flutter is concerned.

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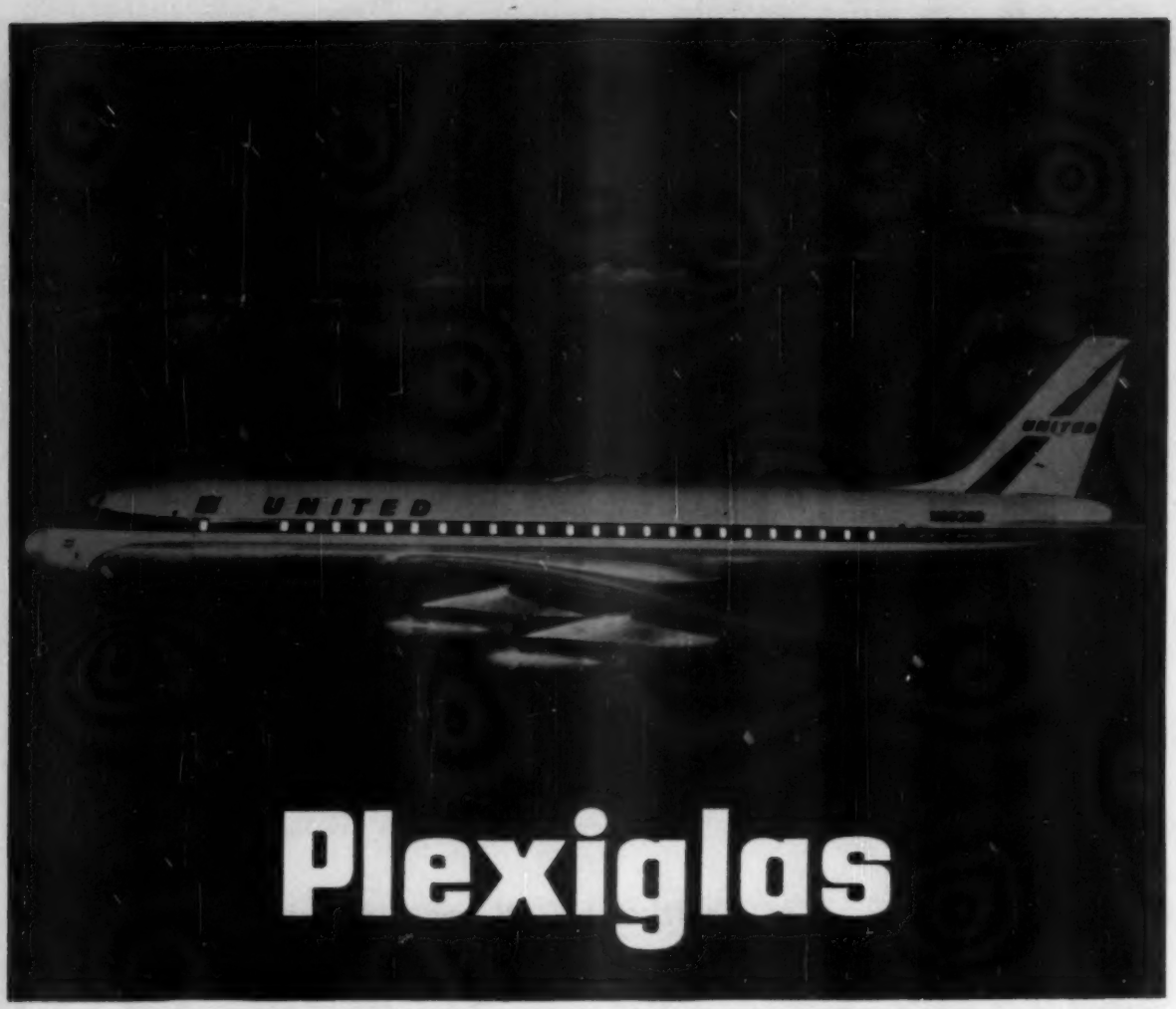

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SIDEWINDER air-to-air infrared tracking missiles are fired from the wingtip launchers of a Lockheed F-104A jet fighter.

Lockheed Stresses F-104-9 High Speed

Burbank—High speed and swift acceleration are being stressed by Lockheed Aircraft Corp. in efforts to sell its F-104-9 (AW June 1, p. 32), based on the assumption that head collision and rear hemisphere will be dominant types of attack for years to come due to missile, fire control and ground control system limitations.

Lockheed feels that superior performance will be required for the fighter and interceptor roles to give a reasonable degree of confidence in attacks against invading aircraft, in view of what is currently known and projected for both infrared and radar guided missile capabilities.

Stripped Down Version

Offering a stripped-down Mach 2 aircraft for international sale, the company emphasizes that the F-104-9 Starfighter will have capabilities which will keep it modern and able to cope with potential enemy aircraft for years to come.

Among the points Lockheed makes are:

• **Aircraft has a potential** of achieving steady state flight at Mach 2.2 to 2.4. This is expected to be accomplished with planned engine improvements; the current limitation of Mach 2 on the Starfighter is an engine turbine inlet temperature function.

• **Airplane can accelerate** in 2.9 min. from subsonic cruise to Mach 2. With this acceleration, the aircraft is better able to perform an intercept and perhaps be able to make more than one pass at an intruding aircraft, due to its margin of speed.

• **With the lower weight** of internal equipment offered as standard equipment on the F-104-9, Lockheed says the airplane's useful time aloft on combat missions is extended above that of the current U.S. operational airplanes. To make the airplane capable of steady-state flight up to Mach 2.4, some material modification would be accomplished in the interior of the engine air inlet ducts. A Pyrex wind screen would be incorporated, and also a new filament-wound radome which has high-speed capability at the advanced Mach number.

Data Indicated

Lockheed data indicates that at 36,000 ft. and Mach 2, the F-104 has 17,300 hp. in excess of that required to actually maintain that speed and altitude.

Company figures indicate the airplane at this altitude and speed can pull 3g constantly, without losing either speed

Interceptor Attack Tactics

	HEAD-ON	BEAM	REAR
• DETECTION RANGE FOR RADAR SEARCH SYSTEMS	MINIMUM	MAXIMUM	ADEQUATE
• DETECTION RANGE FOR IR SEARCH SYSTEMS	NEGLIGIBLE	ADEQUATE	MAXIMUM
• TIME FROM DETECTION TO MINIMUM LAUNCH RANGE	MINIMUM	EXCELLENT	MAXIMUM
• RE-ATTACK CAPABILITY	NONE	ADEQUATE	ADEQUATE
• IDENTIFICATION CAPABILITY	NONE	EXCELLENT	EXCELLENT
• ATTACK CAPABILITY AGAINST MANEUVERING TARGET	NEGLIGIBLE	EXCELLENT	MAXIMUM
• ATTACK CAPABILITY AGAINST ECM	NEGLIGIBLE	ADEQUATE *	EXCELLENT
• INTERCEPTOR SPEED REQUIRED	SLOW	1.2 x TARGET SPEED	MAXIMUM
Conclusion: RELATIVE KILL PROBABILITY	LOW	HIGH	MAXIMUM

LOCKHEED chart details various attack tactics, with rear as the top kill probability.

or altitude, which could be very important on an intercept or a fighter-to-fighter mission.

Fire control equipment being offered with the F-104-9 essentially consists of a fixed-ring optical sight, similar to the 100-mil ring used in World War II, plus the aural provisions which are part of a Sidewinder missile installation. The system would be employed, Lockheed says, by using the 100-mil ring to get the airplane pointed in the general vicinity of the expected target, as an aid to the aural notification which pilot receives when heat-seeking Sidewinder missiles are pointed toward the target within their range of capability. In addition, the 100-mil ring could be tilted, which would enable the aircraft to use it for bombing with two 1,000 lb. bombs which are standard equipment.

The F-104-9 has provisions to carry 1,019 gal. internal fuel, which is 122 gal. more than the standard USAF fighter. The additional tankage is obtained by utilizing the space formerly occupied by the Vulcan cannon and its ammunition. With this quantity of fuel aboard, the F-104-9 has a gross-weight-at-takeoff/fuel ratio of 33.6%. This is without any external fuel carried.

Lighter Than F-104C

The F-104-9 design started from a basic airplane, the USAF Tactical Air Command F-104C. From this were deleted the fire control, cannon and ammunition, emergency power turbine, in-flight and single point refueling provisions, external fuel tanks, provisions for a centerline store, the deceleration parachute for landing, ILS provisions.

Citing the excellent direct maintenance record the F-104 has established at Hamilton AFB, Lockheed attributed this to a $400,000 contract which was issued with the first airplanes, the two experimental XF-104s. This contract was given the company by USAF to design the airplane for minimum maintenance, which resulted in the service center concept which Lockheed followed with the F-104. In this, hydraulics, electrical, electronics, fuel and other systems have individual service center locations, with easy accessibility for maintenance.

What Lockheed is offering is essentially a stripped-down airplane, which the customer can have equipped to perform any mission from the basic interception and day fighter configuration which is the standard design, to a highly sophisticated multi-mission airplane such as the F-104, the German airplane.

Price of the aircraft and maintenance costs increase substantially, of course, with the addition of a more sophisticated fire control system.

Under flexing tests conducted by Wright Air Development Center engineers, this improved ducting showed no damage after 1,000 flexing cycles, 380-390F temperature, and 90-pound-per-minute air flow.

LIKE NEW AFTER 1000 FLEXING CYCLES

THERMOID-QUAKER jet-starter hose has exclusive government approval. Only Quaker jet-starter hose has government approval for use in starting jet engines. This new "Dacron"-and-silicone rubber hose is $200 cheaper for each 30-foot length. Yet it extends the life of pneumatic ducting from 200 to 5,000 engine starts.

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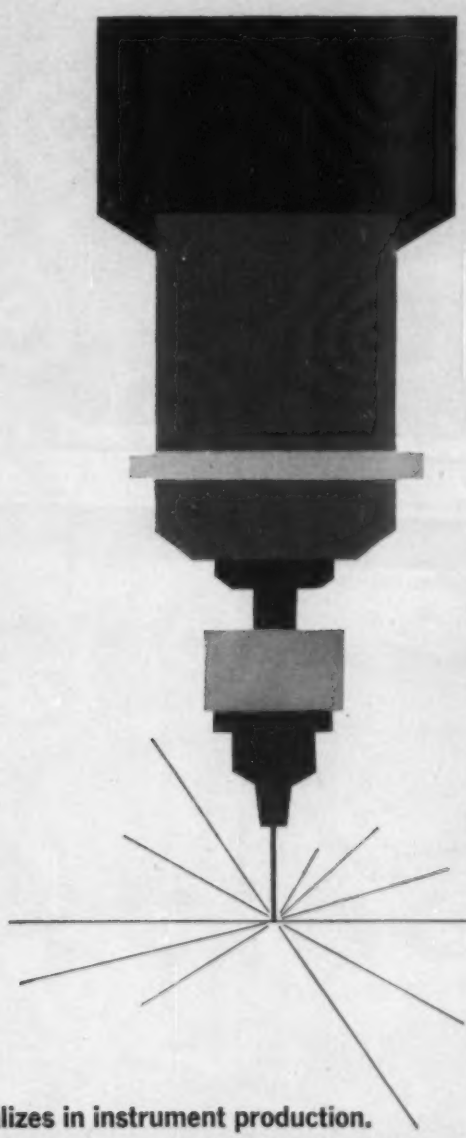

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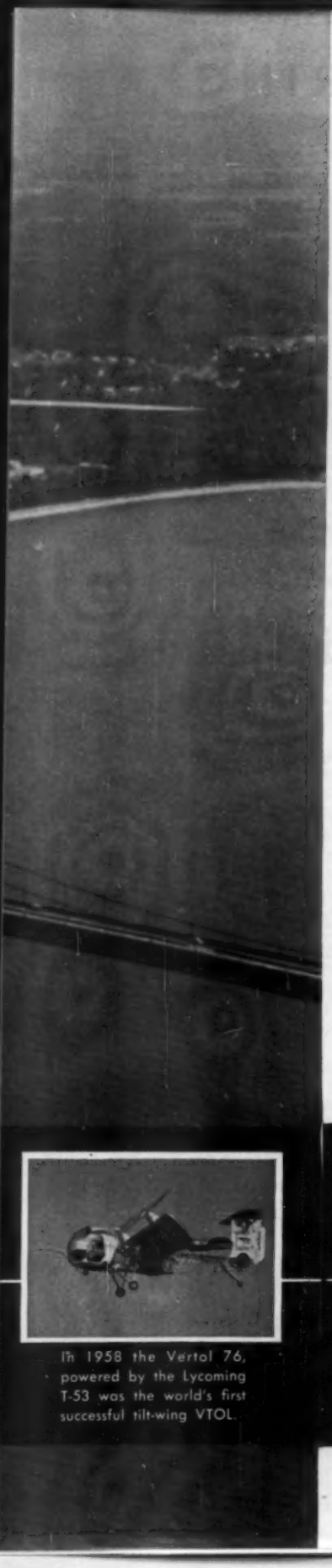
The four-ton H-16, first in Vertol's series of turbine-powered helicopters, flown in 1955.

The H-21D research aircraft equipped with two GE T-58 turbo-shaft engines, flown in 1957.

The Vertol 105 with two Lycoming T-53 engines used in the test programs, flown in 1957.



Why Vertol leads in turbine helicopter design and development

Steady progress in technology has advanced this versatile air vehicle, the helicopter, to the threshold of a new era of usefulness. It is the era of the turbine-powered transport helicopter designed for improved battlefield mobility and logistical support of combat elements and missile systems, and for all-weather, day-night operations in military or commercial service.

Vertol has been and is today at the forefront in progress toward this new achievement. Among the first to recognize that turbine power would vastly improve performance, capacity and versatility, Vertol also is a leader in research and development on new designs incorporating these powerplants.

The result of many years of work in this field is the Vertol 107, first member of an entirely new generation of multi-turbine helicopters destined to play vital roles in short-range transportation throughout the world. It is now being produced for the U. S. Army as the YHC-1A. The "107" can be adapted to an almost limitless variety of functions without altering basic design. Its built-in growth potentiality has already resulted in a decision by the U. S. Military to procure a larger, more powerful version of the 107 type from Vertol. This growth also assures a steady future progression of helicopters of greater performance, load-carrying ability and versatility.

In 1958 the Vertol 76, powered by the Lycoming T-53 was the world's first successful tilt-wing VTOL.

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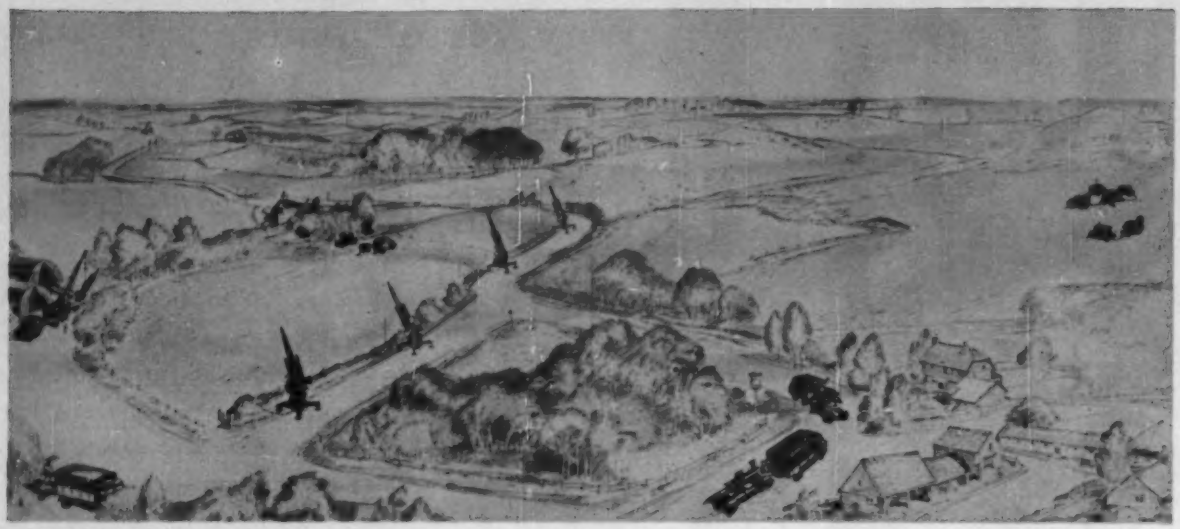


THUNDERBIRD battery consists of four launchers, a target illuminating radar and tactical control radar (far right) and battery command post (left center). Field assembly and test point (far left) is similar to the facility developed for the Corporal missile.

British to Begin Thunderbird Training

TRAINING version of Thunderbird missile is mounted on its launcher in firing position.

London—Two British army anti-aircraft regiments will be equipped with the Thunderbird solid-propellant, ground-to-air missile by December of next year. The first regiment will begin training with the missile next month at the Manorbier anti-aircraft artillery school in South Wales.

A low-level weapon system which may complement Thunderbird in the army's anti-aircraft defense is also undergoing firing trial at Manorbier.

Code-named "Yellow Fever," the radar fire control system of this low-level anti-aircraft weapon incorporates a type of tracking radar and computation system which represents an advance on other known systems, according to an army technical source. The high-speed scanning aerials, computer and the two controllers of "Yellow Fever" all rotate in azimuth with the aerial system on a gun platform.

During a visit to Manorbier AVIATION WEEK was shown the high potential rate of engagement of high-speed jet aircraft possible with the system.

The gun is a developed version of the Bofors light anti-aircraft gun which has a fire rate of 240 rounds per minute. Prime object of the army's air defense policy in the field is the destruction of enemy surveillance aircraft which in all probability will be manned vehicles. Without such surveillance the enemy is unable to define his target from missile attack.

It is now clear with the issue of Thunderbird (code-named "Red

Shoes") to the army that previously rumored defects have been overcome with this missile.

Unofficial sources, normally considered accurate, believe that the Thunderbird ran into trouble only during service proving trials at the British sea firing range at Aberporth, after final engineering changes had been made to meet service requirements.

Recovery on this range is not normally possible and an undisclosed, consecutive number of rounds were fired unsuccessfully before one photographic record revealed partial loss of the control vanes. The vanes, according to one theory, were being struck by the boosters during separation, after having been prematurely over-deflected by a surging condition in the missile's hydraulic system which is energized upon boost separation.

Other reports imply the vanes were failing due to a flutter condition which responded to orthodox treatment.

The Royal Air Force Bloodhound ground-to-air missile is also reported to have overcome some problems occurring during proving trials. Reports suggest that certain directional change rates could cause flameouts due to the disturbance of intake airflow to the ramjet.

System Mobility

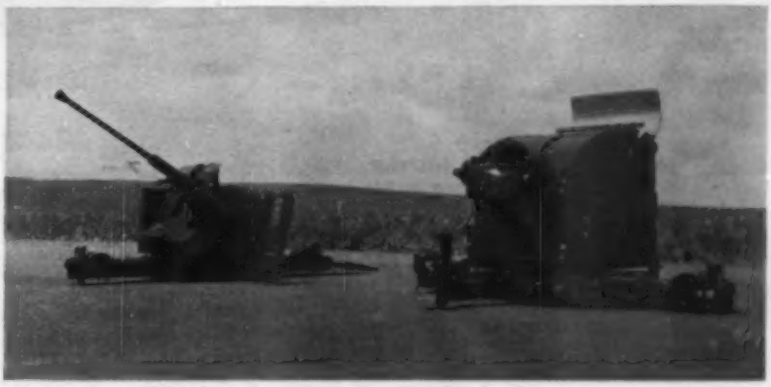
Every element of the Thunderbird missile system is mobile. A regiment is made up of two batteries each consisting of four launchers, one target illuminating radar and one tactical control radar. Each regiment is considered to be at least as mobile as a conventional heavy anti-aircraft gun regiment, the heaviest item being the tactical radar which weighs 16 tons. This radar is only a modified version of the radar used with the previous heavy anti-aircraft artillery. The vehicle currently combines both the scanner and display equipment on the same chassis; and the IFF (aircraft identification) aerial is separate equipment.

Future development is likely to see the breakdown of this radar on two chassis, one vehicle mounting the transmitting equipment with a combined scanner and IFF aerial, and another vehicle housing the display consoles and control personnel.

Under a state of alert, reloading of one launcher can be completed in four minutes so that a battery has a fire power of one round per minute. Normally the army will fire one round with the target at maximum range and be ready to launch a second round at the same target if necessary. The possibility of equipping each battery with two target illuminating radars has not been ruled out, however.

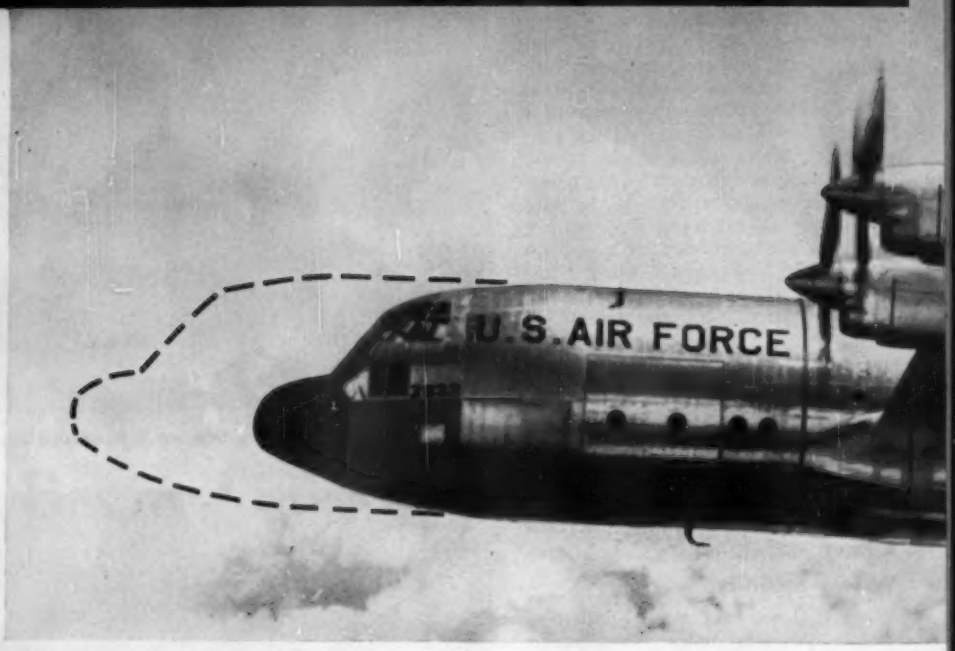
Target illuminating radars for both Bloodhound and Thunderbird are basic-

THUNDERBIRD with boosters attached is transferred from dolly to launcher loader.



LOW LEVEL weapon system above uses Bofors gun and new type radar and computation system. Finless Thunderbird in transtainer below is given go, no-go test from vehicle at left.

New Lockheed Super Hercules
Big brother of U.S. Tactical Airlift champ

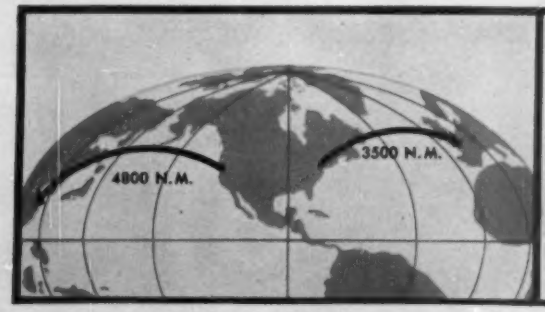


An ocean-spanning logistic support transport, the GL-207 Super Hercules is a "stretch" version of the C-130 Hercules—famous for its headline-making feats in over two years of service with USAF's Tactical Air Forces.

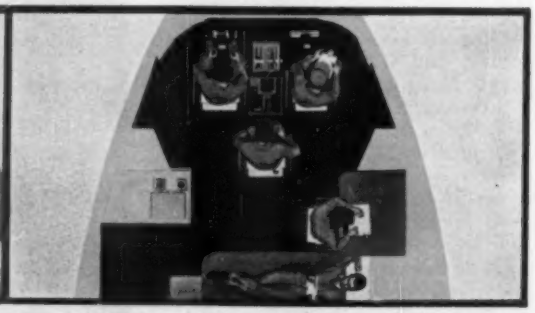
The GL-207 Super Hercules has a fuselage 23 feet longer than its brawny brother's. Its wing span is 12 feet greater... its propeller-diameter has been expanded by 2½ feet... internal fuel capacity has been increased to 10,236 gallons for greater range (pylon tanks add another 1800 gallons).

Powered by four new GM-Allison T-61 Prop-Jet engines, the Super Hercules provides nonstop trans-Atlantic and trans-Pacific transport for personnel, vehicles, palletized/containerized freight, missiles, and general cargo. Maximum payload: 78,000 pounds.

The GL-207 Super Hercules will come off production lines at Lockheed's Georgia Division. Like all Lockheed aircraft, the Super Hercules is designed for long life, easy maintenance, and low cost of operation. Result: maximum airlift, for minimum dollars.

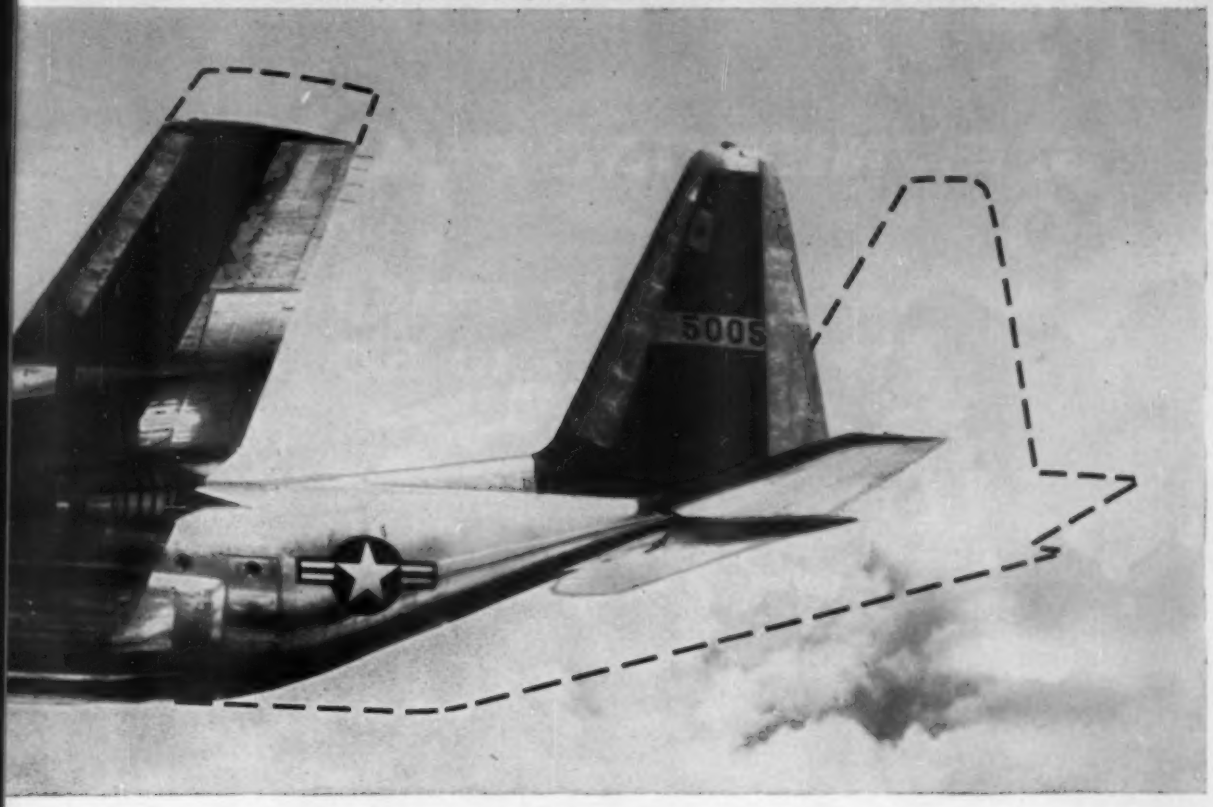


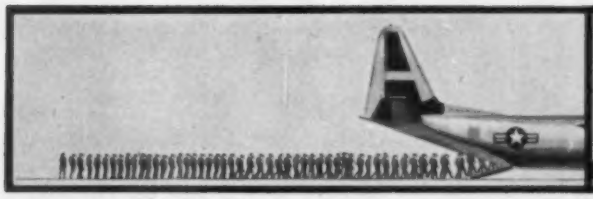
Transporting 50,000-pound MATS cargoes nonstop across the Atlantic—or, with pylon tanks, spanning the Pacific nonstop carrying 16-ton loads 4,800 nautical miles—is Super Hercules' mission.



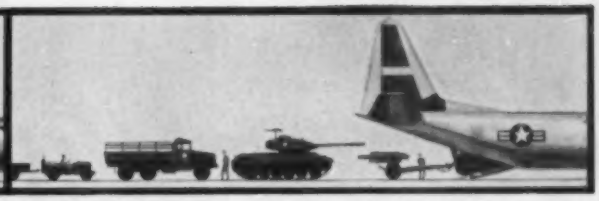
Crew efficiency on long flights is assured by flight station design approved by experienced transport pilots. Super Hercules' crew compartment includes relief crew sleeping space, galley facilities for hot meals in flight.

Dotted line shows size of GL-207 Super Hercules, superimposed over now-in-service C-130 Hercules.

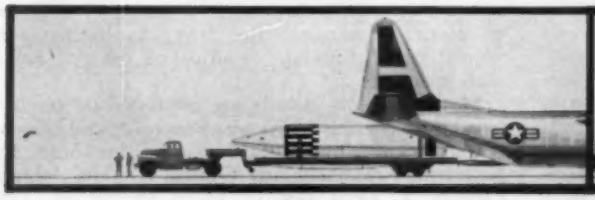




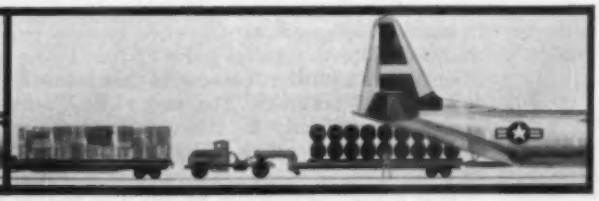
152 combat-ready troops, or 116 paratroopers can be transported in the GL-207. With airline type seats, the Super Hercules can carry 105 persons comfortably.



Combat vehicles can be driven up the hydraulically controlled ramp-door of the end-loading GL-207 Super Hercules—a vital time-saver in emergency situations.



Big ballistic missiles—assembled, with boosters, on trailers, or dollies—fit easily into the huge pressurized cargo compartment of the GL-207 Super Hercules.



Assorted cargo—runway matting, jet engine containers, fuel and oil drums, etc.—can be speedily loaded onto Super Hercules' truck-high cargo floor.

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It is smaller in size and weight than similar platforms and the following features are indicative of the performance to be expected:

1. Fully operable within one minute after power is applied.
2. 20 minutes after −55°C start—it achieves accuracy as specified.
3. Ambient temperature −65°C to + 100°C.
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This lightweight ruggedized environmentally suited platform is ideal for long range air launched missiles. The unusually low drift rate eliminates the necessity of "trimming" or adjusting the gyro before each mission.

More complete details are available on the system by contacting Manager—Control Sales, General Electric Company, Light Military Electronics Department, Armament and Control Section, Johnson City, N. Y., Dept. 12A.

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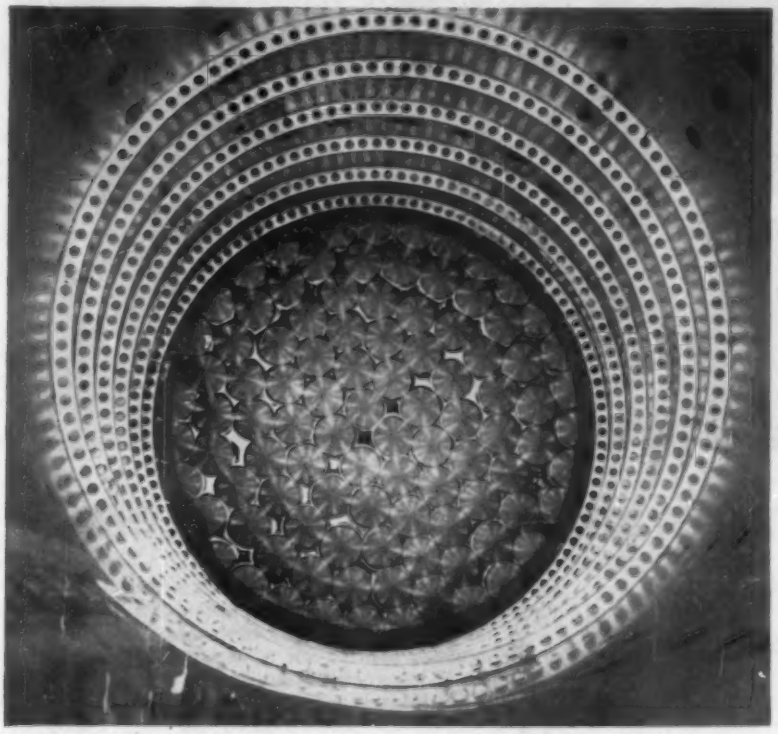
ally similar. Both are made by British Thomson Houston Co., Ltd., but in the interests of mobility, the army equipment had been made lower and smaller, and must inevitably have conceded some range.

A notable feature of the Thunderbird's system has been the adaptation of standard army vehicle chassis for practically all elements of the system. This has greatly reduced the development time of the system as a whole, the army claims.

The battery command post is a standard three-ton vehicle housing the display equipment associated with the radar displays and it houses a special lamp order signaling system which enables the technical control officer to issue orders and receive information. The launchers are an adaptation of the standard Bofors light anti-aircraft gun platform and the launcher loading vehicle is also an adapted army vehicle which has a turntable and extending rails to enable the missile and elevating frame to slide from the launcher onto the launching platform without manual effort.

The field assembly and test point is basically identical to the facility developed for the Corporal missile.

Efficiency of the army training handling methods were well demonstrated. One feature of the training program is an instructional model which simulates the complete radar control and firing system.



PERFORATED brass cans floating in fluid in a missile tank model act as surface suppressors. The rings around the tank wall represent stiffener rings in an actual tank.

Missile Fuel Sloshing Simulated

By Craig Lewis

San Antonio—Simulation technique for examining fuel sloshing characteristics of liquid rocket missile fuel tanks has been developed here by the Southwest Research Institute.

Developed for the Army Ballistic Missile Agency, the simulator will be used as a research tool to examine fuel sloshing phenomena and problems. It also has a design and development application as a means of evaluating sloshing characteristics of specific tank systems for ballistic missiles.

Southwest Research Institute built the simulator for ABMA in an effort to get a more realistic means of evaluating sloshing problems. Most of the work done in this area has been in developing theoretical solutions, and Dr. H. N. Abramson, manager of the engineering analysis section at Southwest Research, observes that fuel motions are too complex to analyze theoretically. He also points out that information from actual test firings is hard to obtain because of the difficulty of telemetering all the data that is needed.

A year ago, ABMA hired the Institute to find out whether simulation would work, and this initial phase of the contract is now nearing completion. A simulator has been built which roughly corresponds to the fuel tank in the Jupiter intermediate range ballistic missile. Southwest Research has found results from this model system to be in close agreement with ABMA tests with a full scale tank.

During the the second year of the program, the Institute will look into various sloshing phenomena and problems, and will evaluate various tank designs and three or four of the devices commonly used to suppress sloshing motions. These investigations will be general, and the program is not aimed at development of any specific missile hardware. In the simulation process, theories in the sloshing field can be checked out with experimental data.

Simulator built by Southwest Research is a universal type of system, and it could be adapted to accommodate any tank configuration. With such flexibility, missile designers could use simulation in the same way that aircraft designers use models in wind tunnel tests to examine the characteristics of a system before the full scale hardware is built. Thus, once the fuel and tank configuration have been chosen, simulation could provide information on sloshing that would be useful to guidance engineers and other designers who must consider sloshing frequencies in developing missile systems.

Tank Model

The tank model used in the simulator has rigid walls, and the Institute program has not gone into the area of structural variations, although Dr. Abramson said this kind of investigation could be done. Data from the model system is handled with straightforward mathematics to effect the simulation. Reynolds number is accounted for in comparing results.

Along with evaluating tank designs and general sloshing characteristics, the simulator can be used to investigate the various types of sloshing dampers designers use to suppress sloshing motions. An example of these devices is a perforated brass can with a cone at each end which is floated on the surface of the fluid in the tank to act as a surface suppressor. Other dampers such as rings and vanes on the tank walls can be checked.

In simulating a tank, Southwest Research technicians don't use the fluid which will go in the full scale tank. They find a fluid with the appropriate kinematic viscosity which acts in the

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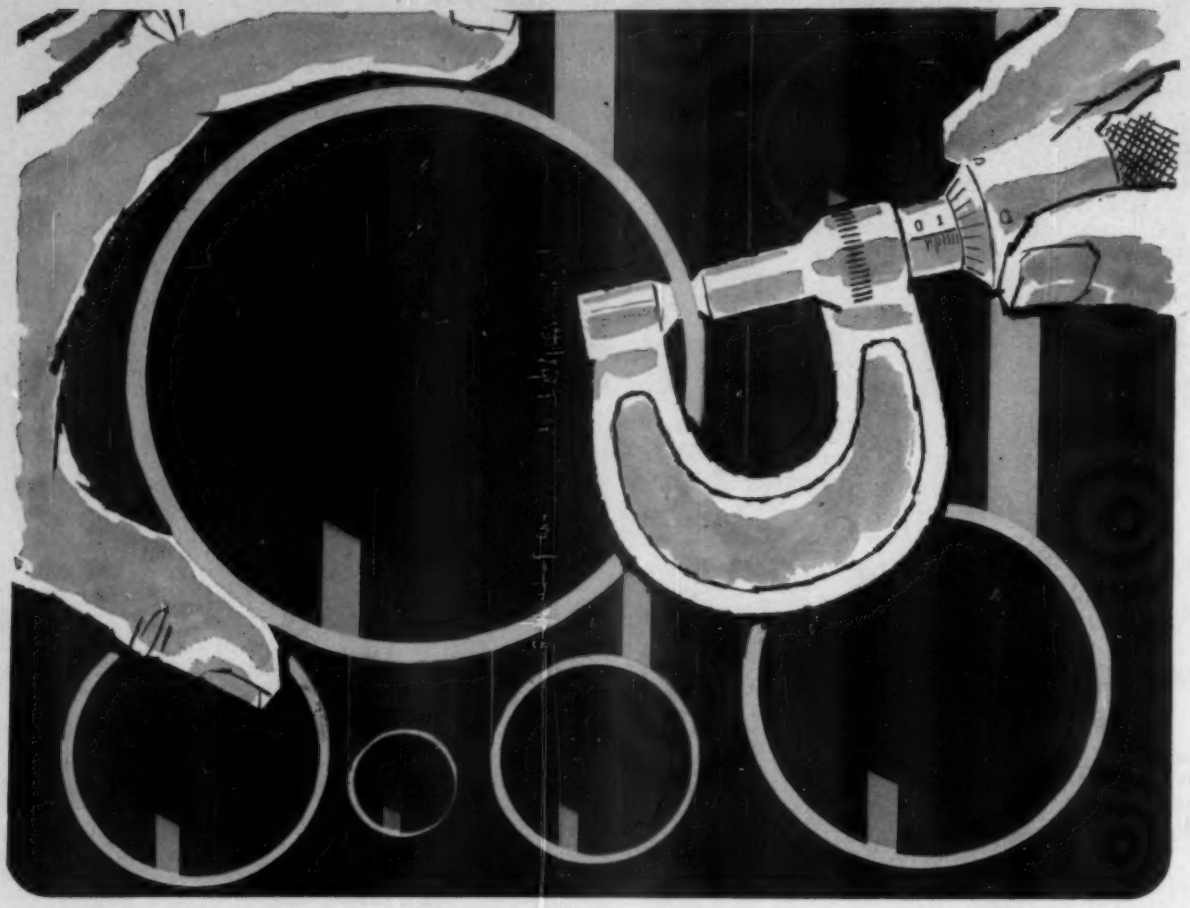

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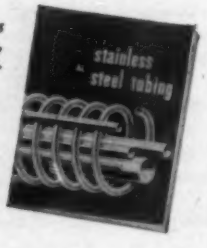

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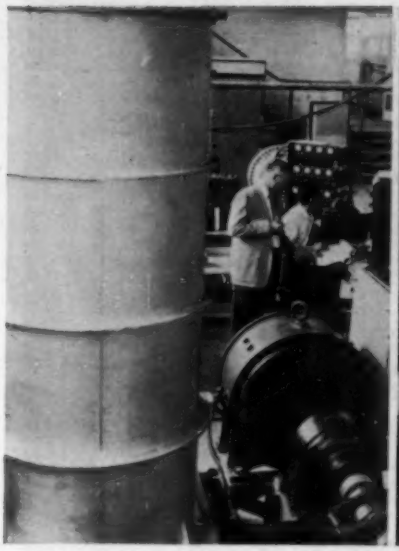


SOUTHWEST Research Institute sloshing simulator (left) has model tank attached to dynamic table driven by 10 hp. d.c. motor. Brass cans being evaluated as surface suppressors are at right. Larger can is 6 in. x 1¼ in.; ping ball inside makes it float at proper level. Smaller can is 3 in. x 1 in. and uses small cork ball on table as float.

model tank the same way the actual fuel will act in the full scale tank. The type of substitute is related to model size and configuration. Fluids ranging from red fuming nitric acid to kerosene can be simulated, but problems arise in finding proper substitutes for oxidizers. Liquid oxygen, for example, is next to impossible to simulate.

Model Tank

Model tank on the simulator now is 14¼ in. in diameter and about 3¼ ft. high, but models up to 2½ ft. in diameter could be accommodated in the present system. Tank model is attached to a platform with four legs which sits on a dynamic table. The table is connected to a 10 hp. d.c. adjustable speed motor through a drive shaft with an eccentric cam and a gear box.

In operation, the system can provide frequencies from ⅓ to four cycles per second and amplitudes from 0.015 to 0.96 in. in each direction, or double that for the total stroke. By removing the gear box, frequencies between four and 30 cycles per second can be obtained with direct drive.

Strain Gages

Measurements are taken from two sets of strain gages. A strain gage on each of the four platform legs gives the total lateral force acting on the wall of the tank, and another strain gage on each leg gives the pitching moment. But these measurements provide not only the force due to the liquid, but also the mass inertia of the tank and the system. So there is a separate balance platform with strain gages and with lead weights adjusted to match the signal from the tank gages when the tank is empty. This balancing signal is fed in 180 deg. out of phase, and the result is a measurement of the forces from the liquid.

Simulator system also has provisions for mounting pressure cells on the tank walls and bottom to give the distribution of pressure over the tank. This data tells what is happening at various points on the tank, and it can be integrated to give total force and check other measurements. All data goes to the system's oscillographs for recording.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Crosley Division, Avco Manufacturing Corp., Cincinnati, Ohio, 48 ea., radio receiving sets, type AN/ARW-62, and 21 ea., radio modulators, MD-131, for use on XGAM-72, YGAM-72 and XGAM-77 missiles, (PR's PE-9-16A-4308, EC-9-16A-4345 and EC-9-16A-4382), $130,000.

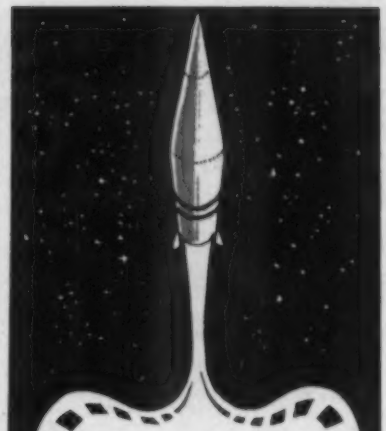
North American Aviation, Inc., Los Angeles, Calif., miscellaneous spare parts for 2.75 rocket package assembly, (PR WR-9-FED10-2005), $39,623.

General Electric Co., Johnson City, N. Y., various components of AF/A42G-7 and AF/A42G-8 automatic flight control systems for F-105E and D aircraft, (PR PE-9-05F-4298), $1,742,500.

Crosley Division, Avco Manufacturing Corp., Cincinnati, Ohio, AN/ASG-15 fire control system for B-52, (PR's WR-9-1270-1018 and EG-9-11E-4625), $151,568.

Heat Exchangers, Inc., Chicago, Ill., 35 ea., temperature control units, type B-1, photo processing, data and spare parts; end use: ground support equipment, IFB 33-600-59-57(PR MO-9-6740-1709), $29,085.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., 170 ea., controls, flight,



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vertical gyro, P/N JG7044A-40, Aerno 60-3870, component of F-101C automatic flight control system, used in F-101A and F101C aircraft, (PR PE-9-05F-4332, $206,550.

Metal Processing Division, Curtiss-Wright Corp., Buffalo, N. Y., acquisition of machinery and equipment. (PR BI-9-F-9111), $2,000,000.

Lycoming Division, Avco Manufacturing Corp., Stratford, Conn., product improvement services for T53 engine, product support (H-43B aircraft program), (PR EP-9-2840-4564), $186,000.

Convair Division of General Dynamics Corp., San Diego, Calif., modification of T-29B type aircraft for frequency monitoring control, (PR's SA-9-01A-5164 and amendment No. 1, and SA-9-01A-5119), $103,681.

Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J., 24 ea., R-3350-32W engines for P2V aircraft, (MIPR R59-1928-25-NOas), $1,871,256.

AiResearch Manufacturing Company of Arizona Division, The Garrett Corp., Phoenix, Ariz., 10 ea., gas turbine compressors (for Navy use), aircraft, unknown, (MIPR R58-877-131-NOas and amendments 1, 2 and 3), $158,214.

B. F. Goodrich Aviation Products Division, B. F. Goodrich Co., Akron, Ohio, 77 ea., wheel assemblies; 149 ea., brake assemblies for YT and T-38 aircraft, spare parts and data, (PR EA-9-03B-4380), $67,797.

M-N Products Corp., Hazel Park, Mich., 180 ea., racks, bomb, 10,000 lb. type U-2A, IFB 33-600-59-99(PR WR-9-F8C10-2002), $37,800.

Marquardt Aircraft Co., Van Nuys, Calif., test time in support of Navy contract, (MIPR R-59-201-118-NOas), $44,913.

Howal-Ronset Instrument Co. Division, Kings Electronic Co., Inc., Tuckahoe, N. Y., 50 ea., controls C1513A/ARN-6, end use: C-130B, C-133B and F-89H aircraft, IFB 33-600-59-93(PR's MD-9-16A-35129; MD-9-16A-35145 and amendment No. 1; PE-9-16A-4250; 00-9-16A-2581 and amendment No. 1; SA-9-16A-5509; 00-9-16A-2113 and amendment 1 and 2), $31,409.

Cosmos Industries, Inc., Long Island City, N. Y., mounts MT-274D and controls C1514A for ARN-6 end use; T-33A and F-86D aircraft, IFB 33-600-59-93(PR's Md-9-16A-35125; MD-9-16A-35145 and amendment 1 and 2; SA-9-16A-5512; SA-9-16A-5510 and amendment 1; SB-9-16A-5042; SM-9-16A-2517; SM-9-16A-2018 and amendment 1), $176,141.

Massachusetts Institute of Technology, Cambridge, Mass., services and reports, automatic programing for machine tools, (PR BM-9-MMP-9080), $150,000.

General Electric Co., Erie, Pa., 370 ea., generators, 1,493 ea., regulators, 180 ea., control panels, component spare parts, machine tools and test equipment, and data for support of F-101B aircraft, (PR's SA-8-03C-4746; PE-9-03C-4255 and amendment No. 1), $1,261,174.

The Magnavox Co., Fort Wayne, Ind., 4,234 ea., indicators, frequency channel ID-573/ARC; 3,815 ea., controls, radio set C-1057B/ARC-34; 419 ea., controls, radio set, C-2006A/ARC-33, end use: AMA class IV modification, (PR, D-9-5821-36025 and amendment No. 1), $869,484.

Helland Division, Minneapolis-Honeywell Regulator Co., Dayton, Ohio, eight ea., oscillographs, visicorders; 239 ea., subminiature galvanometers 16 ea., instruction manuals. (PR 913149-A), $120,250.

Vickers, Inc., Division, Sperry-Rand Corp., Detroit, Mich., 16 ea., fixed delivery hydraulic pumps and parts for evaluation of high temperature, hydraulic fluid properties and their effect on hydraulic pump performance, (PR EM-9-RD-6179), $36,725.

Pioneer-Central Division, Bendix Aviation Corp., Davenport, Iowa, 565 ea., transmitters, rate of flow, fuel, type MA-2, Aerno 61,2458, for use on F-101B and F-105D aircraft, (PR's MA-9-05D-481 and EA-9-05D-4694), $190,624.

Avien, Inc., Woodside, N. Y., product improvement on time-temperature integrators, (PR EA-9-05D-4555), $60,125.

General Electric Co., Waynesboro, Va., 1,950 ea., regulators, voltage, D.C. generator, P/N CR2795B105A1, including data for C-130, C-119, B-47, C-97 and F-100 series aircraft, IFB 33-600-59-112(PR SA-9-03C1-8058, MIPR R59-4197-TCSMC-E), $62,644.

Helland Division, Minneapolis-Honeywell Regulator Co., Dayton, Ohio, three ea., oscillographs, visicorder; three ea., spare visicorder lamps; 34 ea., galvanometers; 200 ea., rolls of recording paper, (PR 913164-A and amendment No. 1), $32,412.

Cemco Industries, Inc., Galion, Ohio, 134 ea., type MB-3 spray outfits in accordance with MIL-S-4907A, spare parts, technical publications and engineering drawings (used as a maintenance platform and for de-icing and decontamination of large bomber, tanker and cargo aircraft, (PR WR-9-1730-3583 and amendment No. 1), $2,605,362.

The General Tire and Rubber Co., Akron, Ohio, 168 ea., nose wheel assemblies, 24 x 7.7, for F-105D and E aircraft; 271 ea., nose wheel assemblies, 38 x 11, for KC-135A aircraft, IFB 33-600-59-106(PR's EA-9-03B-3366; EA-9-03B-4358 and amendment No. 1 and 2), $43,802.

Documat, Inc., Belmont, Mass., microfilm, viewer, type AR-10(3), end use; ground support equipment, (PR MO-9-6730-1604), $94,770.

Aeroflex Laboratories Division, Aeroflex Corp., Long Island City, N. Y., one ea., modified aerial camera mount, type ART-25, end use: unknown, (PR's 64618 and 64623), $34,259.

Fairchild Camera and Instrument Corp., Syosset, L. I., N. Y., 57 ea., camera bodies, still picture, reconnaissance, type K-17D and data, aircraft: type B-52G, (PR PE-9-10A-4176), $84,360.

Radiation, Inc., Melbourne, Fla., development of computing-tracking group OA-UKA, (PR 08506), $197,365.

Connecticut Telephone and Electric Corporation of Meriden, Meriden, Conn., 361 ea., amplifiers, type AM-843A/AIC-10A, Aerno. 81-0166, for support of replenishment spares, (PR's MD-9-16A-35123 and MD-9-16A-35310), $55,293.

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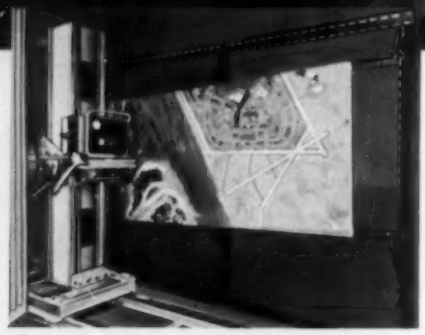

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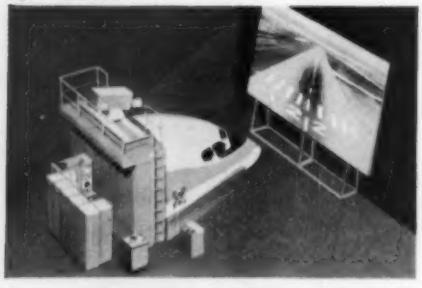

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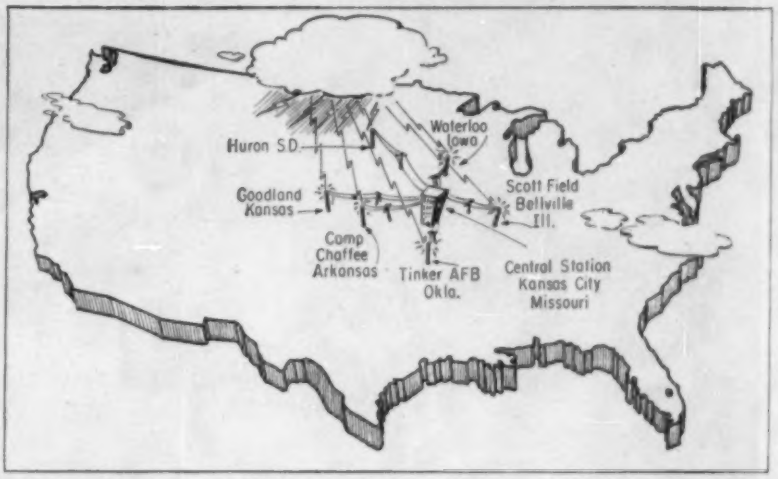
Sferics System May Track Tornadoes

By James A. Fusca

Severe storms and squall lines occurring anywhere in the United States may be detected and tracked by means of a locating system that receives the radio signals generated by lightning strokes—called "sferics"—and plots their geographical position by triangulation. The system, known as Sferics Locating System—AN/FMS-3, is scheduled to be installed next month when it will begin a research and evaluation program.

One of the most interesting possibilities of the system to be explored in the program is that it may be capable of detecting and identifying tornadoes, providing early warning of their existence and routes of travel. Identification techniques to be studied include monitoring of increased lightning activity and frequency shift of the sferics signals believed to be characteristic of tornadoes.

Additionally, the Air Force sponsors of the system believe that it will contribute considerably to meteorological research on the phenomena of severe weather by providing information such as synoptic data on the electrical activity of storms and weather fronts, especially when used in conjunction with other research tools such as weather radar.



SFERICS Locating System AN/FMS-3 will be installed next month with central station at the Severe Weather Warning Center, Kansas City, with six remote stations as shown above

System Integration

The AN/FMS-3 system has been designed for and will be operated by the Air Force. If it proves as useful as is hoped, it probably will be integrated as part of the Air Force's WS433-L weather system. The system was designed by Stavid Engineering, Inc., Plainfield, N. J., under the technical cognizance of the U. S. Army Signal Research and Development Laboratories, Fort Monmouth, N. J., through an exchange of funds by USAF.

Under this arrangement Stavid's contract for the system, which totaled about $440,000, was let by the Signal Corps. The Signal Corps has been active in sferics research since 1943, and has had in operation a smaller three-station experimental sferics detection network of its own.

The AN/FMS-3 system is made of one central control station and six remotely located stations. The remote sferics sets, termed AN/FMD-1, detect the azimuth angle of arrival of a sferics signal and convert this information to binary code form. The coded information is transmitted via telephone terminal equipment to the central station.

The central station equipment, called AN/FMQ-4, decodes the azimuth data from each remote site and by means of an automatic electronic plotter computes the triangulation which is displayed as a "fix" on cathode ray tube display. The tube employs a long persistence phosphor so that lightning activity can be observed by an operator or the total activity over any desired period of time can be obtained by photographic techniques.

A map overlay on the display tube will provide a geographical reference. The system is designed to display fixes within 2,000 mi. of the central station, although the display can be expanded to present only those occurring within 1,000 mi. of the central station. This central station of the system will be located at the Severe Weather Warning Center, Kansas City, Mo., which is operated jointly by the Weather Bureau and USAF's Air Weather Service.

Remote Stations

Three of the six remote stations of the system will be installed at military bases: Fort Chaffee, Ark., Tinker AFB, Okla., and Scott Field, Ill. The remaining three stations will be installed at civil airports: Huron, S. D., Waterloo, Iowa, and Goodland, Kans.

The AN/FMD-1 remote stations of the system convert information on the angle of arrival of sferic signals into an eight-bit binary code which is transmitted in parallel to the central station.

Equipment employed to do this is:

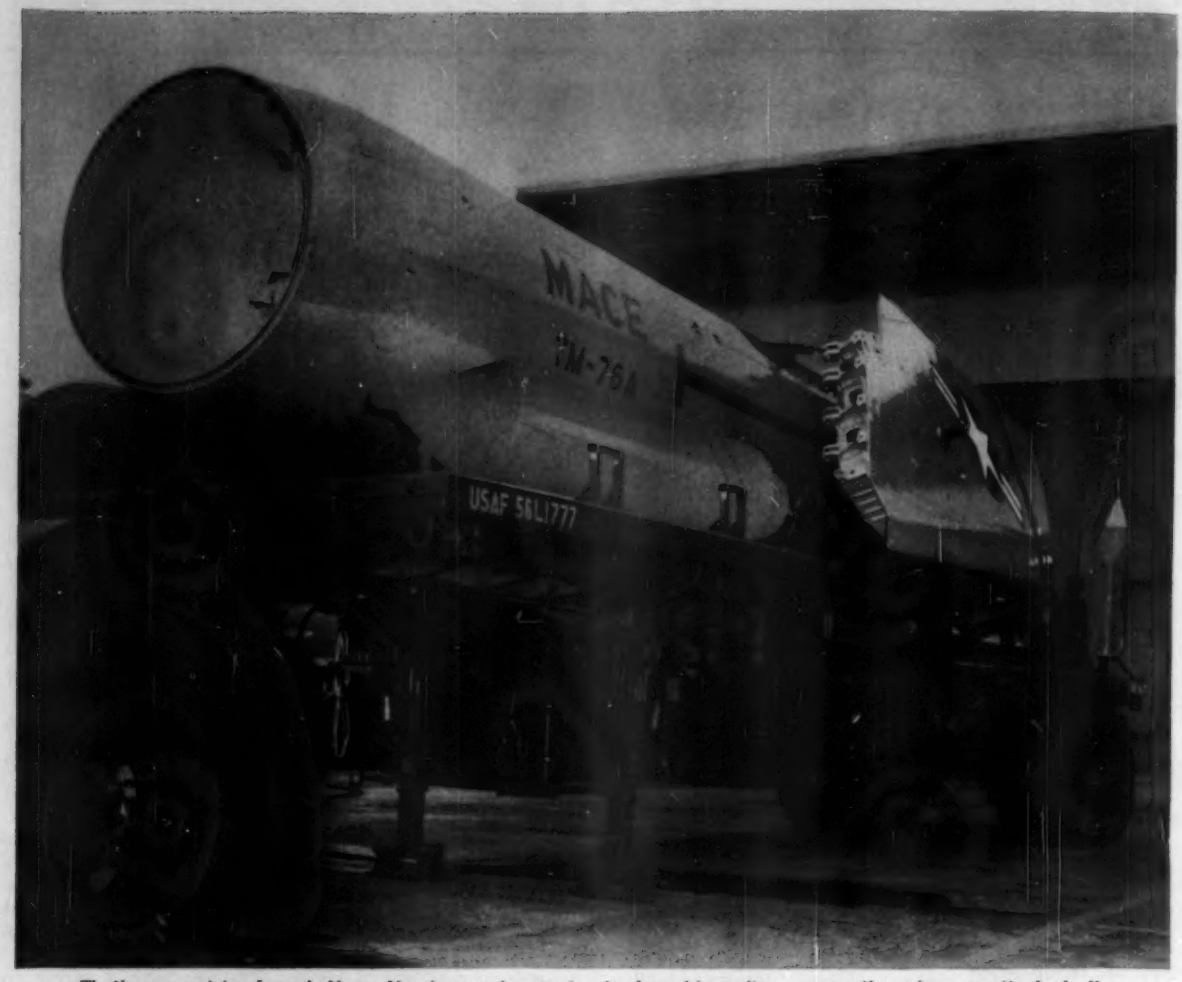
• **Antenna and D/F receiver.** The antenna at each site will be composed of two triangular loops arranged at right angles, each with a base length of 60 ft. and a height of 30 ft. The antenna converts the received sferic signal into two components, North-South and East-West, that are identical in phase but with an amplitude ratio proportional to the angle of arrival of the signal.

The receiver will have a maximum bandwith of 1,000 cycles, and be capable of operating at 10 kc., 50 kc., or 100 kc. so that operation of the system can be studied at different parts of the sferic spectrum. Specifications call for a signal-to-noise ratio of 40 db. for a signal level of 300 microvolts, and for a wide band RF step attenuator with a maximum attenuation of 54 db.

• **Data transmuter.** This unit prepares the output of the receiver for writing a bearing line on an iconoscope scanner. It also provides a circular reading sweep for the iconoscope. The transmuter output is momentarily switched from the reading to the writing signal by a trigger pulse generated by the sferic signal.

• **Scanner and monitor.** The output of the scanner and monitor unit is a pulse with a time relationship to a reference pulse that is a measure of the bearing angle. The monitor also is used for alignment and calibration of the remote station.

• **Timing generator.** The reference pulses and clock pulses needed to synchronize the system and to convert the



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time interval represented by the scanner output pulse into binary code form are produced by the timing generator.

• **Code generator.** This unit converts the gated clock pulses produced by the timing generator as a measurement of the time between the reference and bearing pulses (therefore a measurement of bearing angle) into a parallel eight-bit code which is fed to the eight lines of the telephone terminal equipment that carry the data to the central station.

The remote station equipment is cycled at the rate of 50 times per second; that is, a new bearing signal is transmitted by the equipment 50 times per second. Therefore, each of the six remote sites is capable of measuring bearing angles of up to 50 lightning strokes each second.

Central Station

The AN/FMQ-4 equipment making up the central station installation accepts the bearing data transmitted by each of the six remote stations and stores it in buffer storage units until called for by the individual computer serving that site. The complete system consists of six computers, a timing unit, and a display unit.

• **Computers.** The six computers of the system are hybrid units, employing both analog and digital techniques, designed to solve the equation of the instantaneous distance from a point (the spot representing the moving beam of the display tube) to a given line (the bearing line received from the remote station) as the point moves according to a fixed program.

• **Timing unit.** The basic reference timing pulses used throughout the central station system are generated by the timing unit.

• **Display unit.** The indicator unit presents a rectilinear display of the raster type (where the beam is swept in the same manner as a conventional television set). The display shows the fixes marking the points where bearing lines intersect obtained from the bearing information transmitted by the computers. The display tube is scanned 32 times per second, and presents the fixes as bright spots on the tube face.

System Accuracy

The read-out accuracy of the system is required to be 25 mi. on the 2,000 mi. range, which means that a minimum of 160 scan lines are required for the raster. The actual number of lines displayed is 200. The vertical sweep speed is 32 cycles per second, which includes both the active display time, the additional time required for setting up the computers, and the inactive retrace time.

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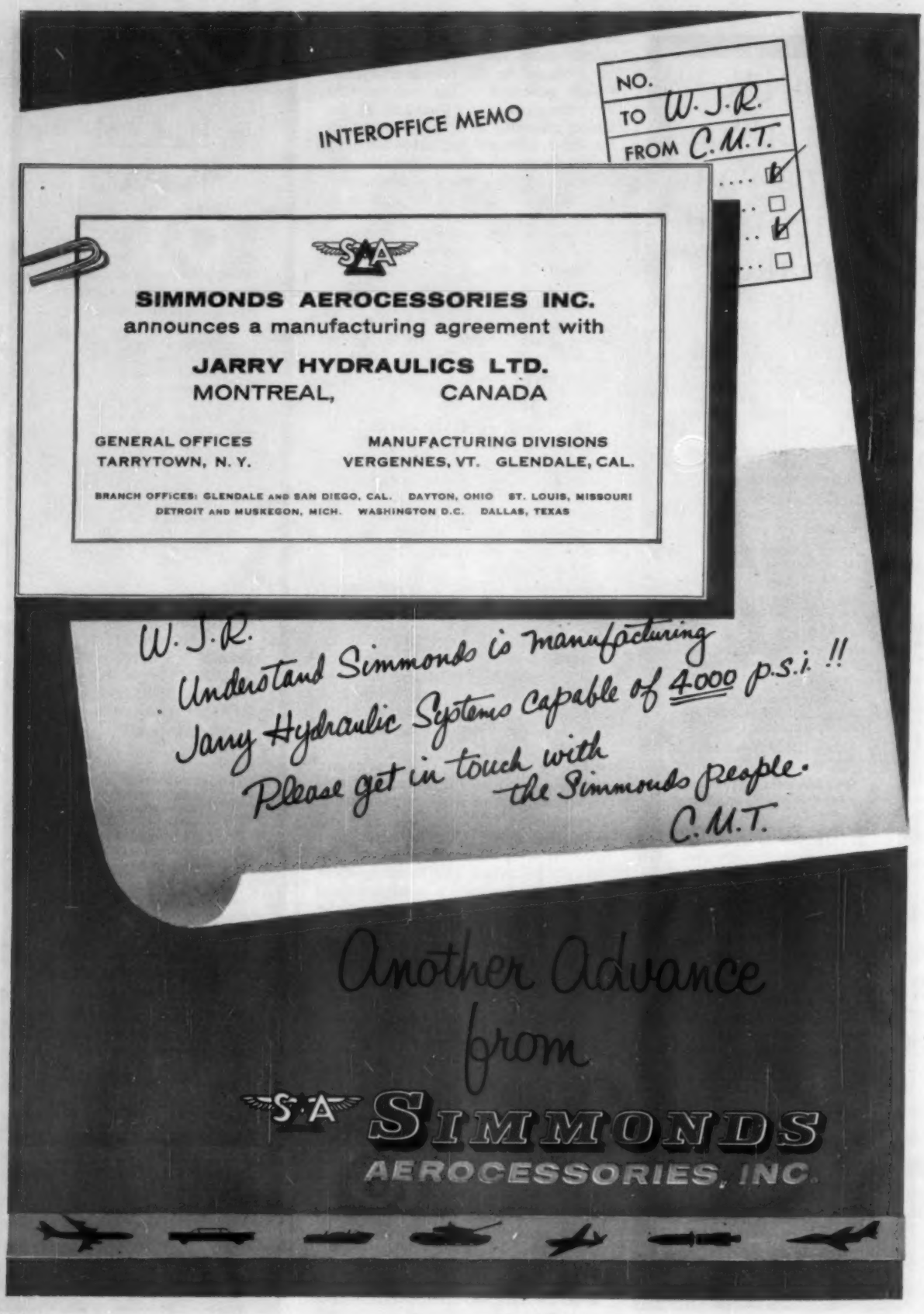
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calculating the intersection points of the bearing lines and displaying the solutions (fixes) on a cathode ray tube indicator. The physical representation of the problem involves the measurement of the distance between a point and a line.

The bearing line received by the computer can be described as passing through the coordinate points of the remote station as depicted on the display tube at some angle theta. The point can be described as the instantaneous position of the spot generated by the scanning beam of the display tube as it scans the face of the tube.

Any type of reference system could be used for the computer and display, but the two most general systems used for both purposes are rectangular and polar coordinates. Although there are many advantages in the handling of angular information in polar coordinates, Stavid decided that the problems accruing from having more than one origin (the six remote stations) were too difficult for high-speed instrumentation.

For this reason, rectangular coordinates are employed both in solution and display.

The solution of the problem is to provide spot intensification by the scanning beam at the time that the distance, horizontally or vertically, between the spot and intersection of two or more bearing lines is at or some arbitrary distance close to zero.

Each computer solves the problem of the distance between the scanning spot and the bearing line received from the remote site and provides a solution in the form of a gating pulse that begins as the scanning spot approaches within the selected arbitrary distance of the bearing line, and terminates as it travels beyond the selected distance.

A fix selector and error polygon resolver circuit receives these gated bearing pulses from each of the six bearing computers, sums their amplitudes, and compares the summed waveform with a reference voltage to determine whether or not a valid fix has been received. (The error polygon is the geometric figure produced by the intersection of three or more bearing lines.)

A selector switch on the control equipment enables the operator to select the number of overlapping bearing pulses required to display a fix. The switch can be set so that two or more, three or more, or four or more bearing line intersections cause a fix to appear on the display.

The problem to be solved by each bearing computer during each individual display period requires the multiplication of a varying analog quantity by a static trigonometric function. Since the binary code representing the

Famous PRATT & WHITNEY AIRCRAFT J57 Jet Engine, power plant for Air Force "Snark" guided missile, is geared for both commercial and military performance by *Perkins*. Typical tolerances on *Perkins* gears: .0004 tooth to tooth; .0015 cumulative; .0005 on involute. On spline: .0006 tooth to tooth; .0008 cumulative; .0005 on involute. Most *Perkins* gears are carburized, hardened and ground.

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Rigid PRATT & WHITNEY AIRCRAFT precision requirements spell *performance* . . . top-flight performance. Reason: The future is at stake. And that future can well ride on gear teeth. Since 1940, PRATT & WHITNEY AIRCRAFT gear tolerances have been *Perkins'* standards . . . for commercial gears as well as aircraft. Such precision pays off in longer wear, greater efficiency, lower maintenance cost. That type of precision can pay off for you, too.

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HOW SAC's "HOUND DOG" SCENTS ITS TARGET

The crew of the B-52G starts up the jet engine of the sharp-nosed GAM-77 Hound Dog missile hung under its wing... gives its inertial autonavigator the location of the target.

On a "for-real" mission, the Hound Dog would leap toward its target at supersonic speed—very likely a ground-defense center hundreds of miles away. Its guidance system can't be jammed... can't be decoyed.

Purpose of the GAM-77 air-to-ground jet-powered guided missile is to increase the striking power of Boeing's B-52. Sling a pair of Hound Dogs under the wings of the new B-52G—and you have what amounts to a brand-new weapon system.

The GAM-77 program was started in August, 1957. The missile has been put into accelerated development. It already is in its early flight test phase... will be deployed by 1960.

Weapon system contractor: the Missile Division of North American Aviation.

MISSILE DIVISION NORTH AMERICAN AVIATION, INC., DOWNEY, CALIFORNIA

value of the bearing angle theta from the origin is repetitive each 45 deg. in the last five orders, the computer employs tangent functions to obtain a solution even though four individual computing equations are required. The use of the tangent equations reduces digital switching logic by a factor of two to one at the expense of only slightly more complex setup logic.

Hallamore to Design Titan TV Equipment

Hallamore Electronics Division of Siegler Corp. has received new contract awards totaling $400,000 from the Martin Co., Denver, for the Titan missile development program.

The $15 million development by Hallamore for the Titan program provides a four-point project to include development and installation of photo-optical, film camera and closed circuit TV systems and line communications facilities involving telephone and intercom circuits.

Closed circuit television equipment to be installed will be used at the Titan static test site and includes the latest versions of Hallamore's "ruggedized" camera unit, built to withstand forces of up to 100g only a few feet from the impact point of test firings, with resultant extreme temperatures in the firing perimeter.

Nortronics Studies Guidance Checkout

Hawthorne, Calif.—Preliminary studies are being conducted by Nortronics Division of Northrop Corp. on an advanced system for checking function of weapon systems equipped with inertial guidance. The concept, called "Norscan," would be designed for use with air-launched ballistic missiles, manned bombers, early warning aircraft, and high performance fighters, and represents an extension of engineering accomplishments in the field of computers.

Flexibility of the concept provides a computer system which may be used during factory checkout, engineering test or field operation of a weapons system. Norscan can be adapted for tests of flight control, guidance, fire control, communications navigation and homing systems.

Norscan involves a self-checking, automatic computer programed device employing solid state electronics. Heart of the system is an internally programed computer with a magnetic drum as its principle memory unit, designed to have storage capacity of 500,000 bits of information.

A feature of the concept is the con-

SPACE ORIENTED ELECTRICAL ENGINEERS AND PHYSICISTS

Vast new space and missile projects have created outstanding opportunities in research, development and design at Douglas. Here are some of the areas in which we have immediate openings for engineers and physicists with advanced degrees (B.S. also considered):

SPACE NAVIGATION — Utilize Bode and Nyquist techniques, root loci, Z plane, quasi linear, non-linear and other techniques in the analysis and development of guidance and control systems.

SPACE COMMUNICATIONS — Telemetry system research and development, research in wave propagation in ionized gas, high frequency breakdown and many other areas.

SPACE POWER — Unconventional power research and development to supply power in space stations and on other planets.

LOGICAL DESIGN — Solid state digital circuits as applied to automatic test and firing equipment, utilization of complex switching and logic circuitry, and utilization of computers in detailed circuit design.

ANTENNA DEVELOPMENT — Complete research, advance design and development of antenna and radome systems for use on space vehicles.

For full information write to Mr. C. C. LaVene, Staff Asst. Vice-president, Engineering, Box 620-M, Douglas Aircraft Company, Inc., Santa Monica, Calif.

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You can relax in a quiet cabin and enjoy the ever-changing panorama through new type optimum vision windows unobstructed by engine pods

U.S. patent 2863.620 British patent 774.652 Brevets S.G.D.G.

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SMALLEST LIGHTEST CARCINOTRONS

with wide band sole tuning

Though it has just recently made its debut into the high society of Litton microwave tubes, this M-Type carcinotron (our model L-3298) has already been commended by the military for its exceptionally clean design. Every engineer concerned with upgrading the performance of ECM equipment will surely find much of interest in this medium-power tube, with which Litton takes a major stride toward truly simultaneous noise-jamming capability by affording faster tuning rates than any previously attainable.

The Litton family of eight electrically-compatible carcinotrons is the first to incorporate the critical capability of wide band sole tuning without frequency or power holes when the tube is operated into as much as a 2-to-1 mismatch. Litton carcinotrons are the first to use wider-than-normal-band RF output couplers, minimizing many system components such as antennae, waveguide plumbing, and load isolators.

We cite these firsts not for glory's sake, but rather for their meaningful contribution to more efficient system design, smaller size and lighter weight.

The notable suitability of these carcinotrons is not limited to ECM. You can also consider them for other military applications such as drivers for communications links—in fact, wherever medium-power tubes with extremely rapid tuning and low tuning power are required. And while you are considering, remember: these versatile tubes are not just drawing-board products—you can order them now.

Feel free to lodge your inquiry about voltage-tuned power oscillators of whatever nature with us at Litton Industries Electron Tube Division, Office A6, 960 Industrial Road, San Carlos, California. Your request for our newest catalog or for answers to your specific questions will be honored promptly.

LITTON INDUSTRIES Electron Tube Division

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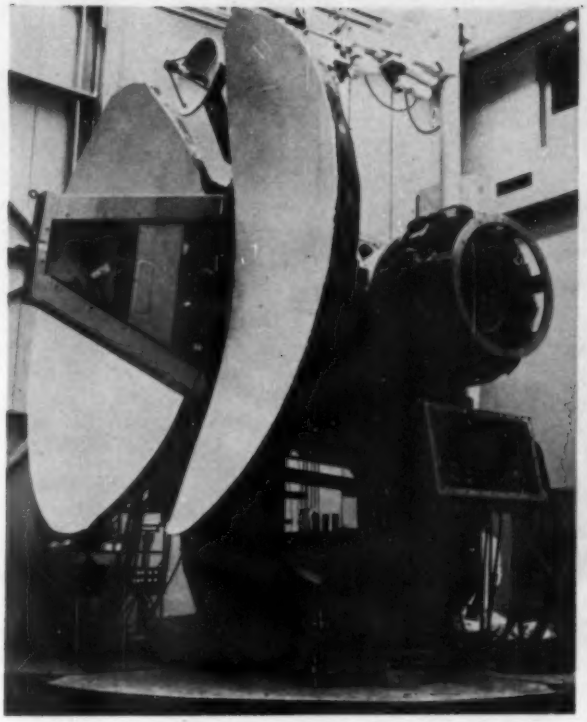
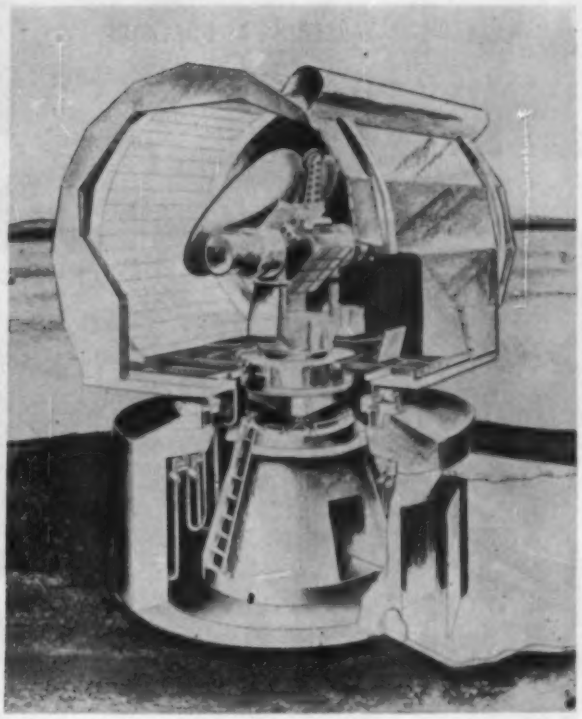




Radar Tracker Developed for Atlas ICBM Squadrons

Atlas intercontinental ballistic missile guidance radar (left), to be used in early Atlas squadrons, is able to determine position of the missile with an accuracy of better than one part in 100,000, according to General Electric's Ordnance Department, which produces the radar tracking antenna. Tracker is installed in a radome (sketch at right) where the temperature is controlled to within ½-deg. To achieve its high accuracy, the bearing race of the radar's 4 ft. diameter base is machined to tolerances of 50 millionths (0.000050) of an inch. Gearless power drive permits tracker to move at extremely slow rates without backlash or roughness.

fidence index which Nortronics engineers claim they can build into the system. This would furnish an indication of the proximity of a "go" reading to the design center of the item analyzed. Engineers also are studying the possibility of a drift index to provide failure prediction due to drift.

Expansions, Changes In Avionics Industry

Computer Sciences Corp., Los Angeles, is a new company formed to serve both computer manufacturers and users in feasibility studies, applications programing and problem analysis for both scientific and data processing work. Company is headed by Fletcher Jones, former general supervisor of integrated data processing at North American Aviation's Columbus Division.

Other recently announced expansions and changes in the avionics industry include:

• **Hermes Electronics Co.** is the new name of the former Hycon Eastern, Inc., Cambridge, Mass.

• **Caswell Electronics Corp.** is the name of a new company formed to develop and produce microwave transmission line components. Dwight Caswell is company president. Company address: 414 Queens Lane, San Jose, Calif.

• **Sperry Gyroscope Co.** plans $6 million expansion of its microwave tube facility at Gainesville, Fla., with a 28% increase in plant space to a total of 121,000 sq. ft. Employment is expected to reach 800 by mid-1960, Sperry says. Company also has acquired a 52,000 sq. ft. building in Syosset, Long Island, N. Y., to house engineering activities associated with Sperry Navigation equipment for Polaris-launching submarines.

• **Lear, Inc.** has divided its former Grand Rapids Division into two new divisions. Instrument Division, headed by J. M. Walsh, will be responsible for flight indicators, gyros and stabilized platforms, automatic bombing systems and ground support equipment. Electro Mechanical Division, headed by T. K. Greenlee, is responsible for fractional horsepower motors, actuators and control systems.

• **North American Autonetics Division** has started construction of new 162,000 sq. ft. manufacturing facility near its main plant in Downey. Completion is scheduled for January.

• **Cominol Industries, Inc.,** Washington, D. C. has acquired Granite State Machine Co., Inc., Manchester, N. H., producer of shipboard countermeasures antennas. Henry L. Hebert, president of Granite State Machine Co. joins board of directors at Cominol Industries, according to David J. Shamp, president.

• **Epsco-West** has moved into a new 20,000 sq. ft. facility near Anaheim, Calif.

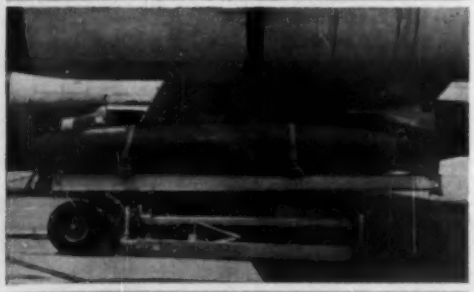
• **International Electronic Research Corp.,** Burbank, Calif., has licensed Garrard Engineering and Manufacturing Co., Ltd., of Swindon, England, to manufacture and sell IERC heat-dissipating tube shields throughout the British Commonwealth.

• **Haydu Industries Corp.** is the new name of the former Haydu Electronic Products, Inc., Plainfield, N. J.

• **Acoustica Associates, Inc.** has acquired Universal Dynamics Corp., Santa Barbara, Calif., maker of piezoelectric ceramics for use in ultrasonic and sonar equipment. New acquisition, headed by Harry W. Kompanek, company founder, will be operated as wholly owned subsidiary.

• **Raytheon Co.** has acquired Machlett Laboratories, Inc., Springdale, Conn., and will operate it as a subsidiary, headed by W. E. Stevenson, incumbent president. Machlett produces X-ray tubes and high voltage electron tubes for commercial and military uses.

...NEWS IS HAPPENING AT NORTHROP



Shown above: Northrop's T-38 Talon, F-89 Scorpion and SM-62 Snark – all served by Nortronics' mechanical, electronic and servo-hydraulic GSE applications.

For the Hawk missile, Nortronics supplies Raytheon Manufacturing Co. with the loaders, launchers, and auxiliary handling equipment. Throughout concept, design and production, Nortronics has kept this program on – or ahead of schedule.

NORTRONICS TOTAL GROUND SUPPORT – KEY TO DEFENSE READINESS!

By integrating mechanical, electronic and servo-hydraulic skills into a wide variety of ground support equipment applications, Nortronics demonstrates an understanding of the total weapon system.

Nortronics conceives, designs and manufactures GSE around a knowledge of the weapon's mission, its operational and maintenance concepts, and the facilities and skills of its field operators.

Twenty years of specialized experience gives Nortronics the ability to get the job done – to translate your most complex GSE requirements into reliable hardware – on time – and at minimum cost.

For immediate help with your GSE requirements, call Nortronics today. Or write: Chief Applications Engineer, Dept. 2003-D3, Nortronics, 500 E. Orangethorpe Ave., Anaheim, California.

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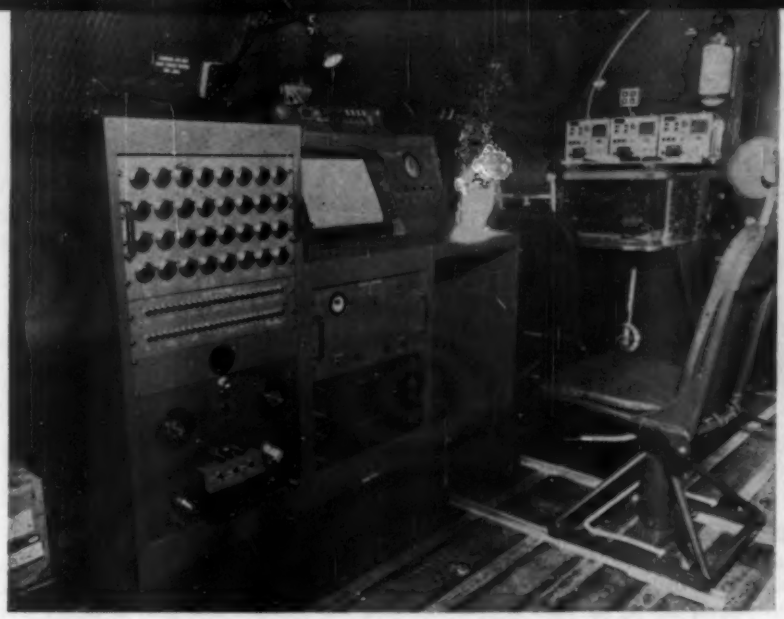
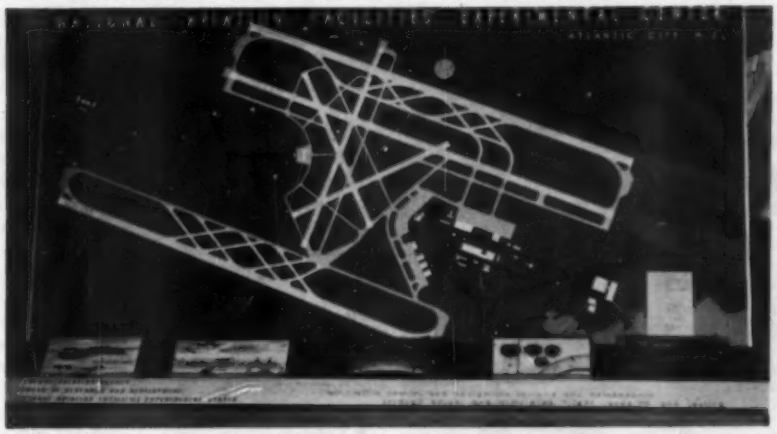


FAA Begins Facilities Center Construction

Federal Aviation Agency's 6,000-acre facility at Atlantic City, N. J., will be used to develop efficient air traffic control for civil and military flying. Various approach configurations are evaluated with equipment shown above; system is aimed at developing high intensity operations below 200 ft. and ½-mi. visibility. Unit shown is in Douglas C-54G; crews have made several landings at zero ceiling and ⅛th-mi. visibility.



Longest runway, now 10,000 ft., will be extended to 12,000 ft. this year and a parallel 12,000 ft. runway will be constructed, as shown in the field layout above. Next year another, and parallel, taxiway and 12,000 ft. runway will be built a mile distant. Total base population, including permanent contractors, will exceed 1,500 in next 18 months. Below is the new control tower for National Aviation Facilities Center operations.

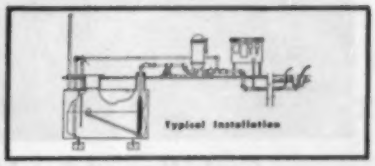
CHOOSE REDA PUMPS FOR YOUR AIRCRAFT REFUELING SYSTEMS!

VISCOUNT refuels at Tulsa Municipal Airport using Reda Jet-Fuel Submergible Pumps.

REDA **Jet-Fuel** Submergible Pumps Give These Important Advantages:

- **Underground Installation** — no surface structures.
- **No Explosion Hazards** — U/L approved models.
- **No Stuffing Boxes To Leak** — motor & pump in one unit.
- **High Volume at Required Operating Heads** — Models from 1 to 150 HP — capacities to over 1000 GPM.
- For single or double hydrant systems, tank truck and test stand refueling systems.

Illustrated is a typical Underground Storage and Hydrant Refueling System with Reda Jet-Fuel Submergible Pumps, used by Continental Air Lines. This system uses two storage tanks and two Reda pumps feeding into a filter and hydrant refueling system. *It has proved to be less expensive in both installation and maintenance than a conventional tender system would have been.*



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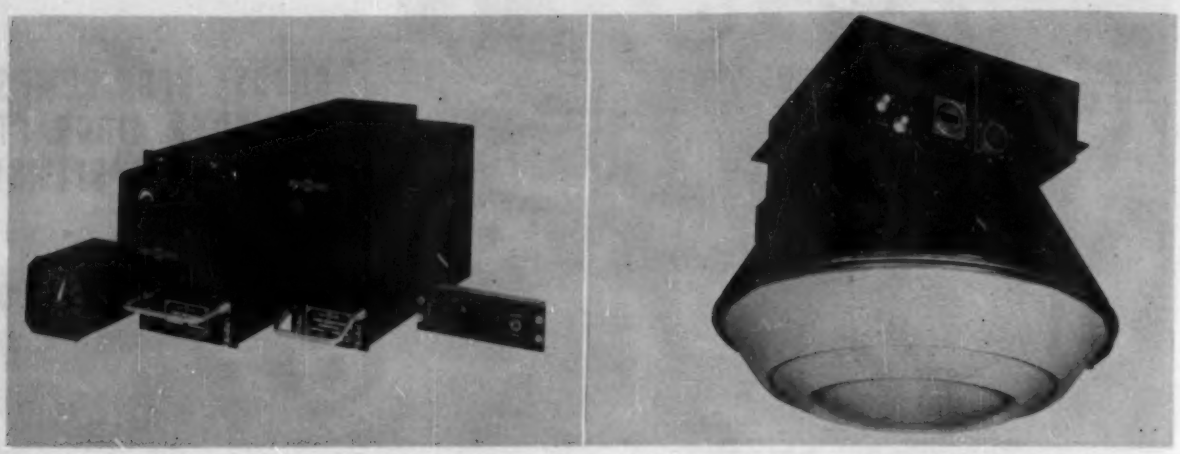
World's Largest Manufacturer of Submergible Pumps for Oil, Brine, Water, Gasoline, Jet Fuel, Chemicals and LPG, for over 35 years.



Collins Radar Measures Ground Speed, Drift

New Collins Radio Co. Doppler radar for measuring ground speed and drift angle can operate from zero altitude up to 50,000 ft. The system, including panel instrument, computer, tracker, transmitter-receiver, control and antenna (shown at right) weighs 56½ lb., or 98½ lb. of dual installation. The system is largely transistorized, usiag 11 tubes and 40 transistors, and consumes 200 watts of power. The antenna generates three beams and is a fixed-lens, horn-fed type with no active elements. System is accurate to 0.6%.

FILTER CENTER

▶**Master Flight Data System**—Litton Industries has won Wright Air Development Center competition to develop an integrated master data and control system for exotic aircraft operating at altitudes up to 200 mi. System will include gyro stabilized platform, external environment sensors, autopilot and digital computer. Eclipse-Pioneer is major subcontractor to Litton.

▶**Crystal Ball Gazing**—Electronic Industries Association predicts that nation will be spending $14 billion annually for aircraft, missiles and space in 1970 and that 43% of this figure ($6 billion) will go for electronics. Of current $11 billion total, approximately $3 billion, or 27%, goes for electronics, EIA estimates. Current military electronics expenditures, including ground and ship-based equipment, estimated at nearly $5 billion, are expected to reach $12 billion by 1970, EIA says.

Coil Wound for Mach 20 Wind Tunnel

General Electric technicians wind an induction coil, believed to be the largest yet built, to store energy for an Air Force hypersonic wind tunnel at Arnold Engineering Development Center, Tullahoma, Tenn. Finished coil will contain about six miles of cable, weigh 60 tons and stand five feet high. Company said the coil will have 1,000,000 amp. of current flowing through it and must withstand magnetic clamping forces as high as 6,000 tons at midpoint. This energy is discharged as a superheated spark to explode compressed air, driving it through the tunnel at Mach 20.

▶**New Magnetic Potentiometer**—Semiconductor device whose resistance can be changed over a 10:1 range through application of a 10 kilogauss magnetic field, or a wider range if stronger field is used, is now available from Ohio Semiconductors, Inc. New Magnetoresistor can be used as a contactless potentiometer, transducer, voltage regulator or power amplifier. For technical bulletin, write company at 1035 West Third Ave., Columbus 8, Ohio.

▶**Subminiature Time Totalizer**—Novel lightweight, low-cost device for keeping track of usage time accumulated by avionic equipment has been developed by Red Bank Division of Bendix Aviation. Device is a subminiature gas discharge tube, Type 7414, with a collector whose resistance decreases uniformly with time up to 1,000 hr., when d.c. voltage of 140 to 250 volts is applied. By measuring resistance of tube, total in-use time of associated equipment can be determined. Publication R93-6 gives application data. Company address: Eatontown, N. J.

▶**Welcome Innovation**—Western Electronic Convention (Wescon), to be held Aug. 18-21 in San Francisco, will limit each of its sessions to three technical papers instead of the four or five

usually squeezed into technical conferences. Another innovation will be a panel of several experts in the field who will be invited to comment at the conclusion of each paper. Copies of Wescon papers will be distributed at time of registration, according to Wescon officials.

▶**UAL Finds Taper Pins Reliable**—Flight tests to determine reliability of new AMP taper pin type of solderless connectors in airline service, conducted by United Air Lines using special fixture with 480 taper pin terminations, revealed not a single failure during 5,816 hr. of flight time extending over 1½ year period. Test unit was installed in wheel-well fire wall of a DC-7 engine nacelle where it was subjected to continuous 2g vibration, temperature cycling and exposure to various types of liquid thrown up during takeoff and landing.

▶**Signed on the Dotted Line**—Major contracts recently announced by avionics manufacturers include the following:

• **Melpar,** $2.5 million award from Air Materiel Command for flight simulators.

• **Westinghouse Electric's** Electronics Division, $7 million contract from Navy Bureau of Ships, for "jam-resistant" radio communications transmitters.

• **Aircraft Armaments, Inc.,** Cockeysville, Md., $491,506 contract from Army Ordnance for development of an electro-visual fire control system for night-time sighting of ordnance equipment. Allen B. Du Mont Laboratories, Inc. is major subcontractor on the program.

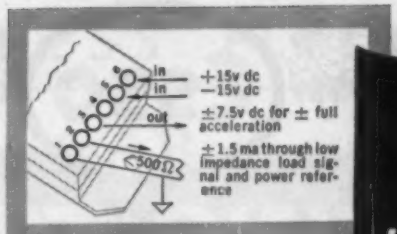
• **Waste King Corp.,** Los Angeles, $300,000 contract from Eastern Air Lines for flight recorders to be installed on airline's fleet of DC-8 jetliners.

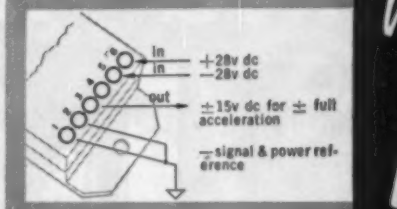
• **John Oster Manufacturing Co.,** Avionic Division, Racine, Wis., contract from North American Aviation for in-flight jet-engine monitoring instrumentation for use on B-70 Mach 3 bomber.

• **Topp Industries, Inc.,** Los Angeles, $356,662 contract from Federal Aviation Agency for VOR omnirange equipment.

• **The Magnavox Co.,** Ft. Wayne, Ind., has received initial contract for $13.5 million for new lightweight radar. Company says it expects additional large orders for the equipment.

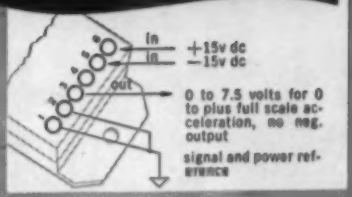
• **ITT Federal Division,** Clifton, N. J., has received order for distance measuring equipment (DME-T) for use on TWA's 30 new jetliners. Company also reports a $11.4 million contract for duplex high-powered radio amplifier for data link guidance system used with SAGE air defense network.

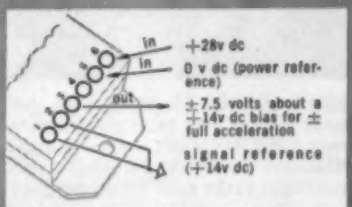


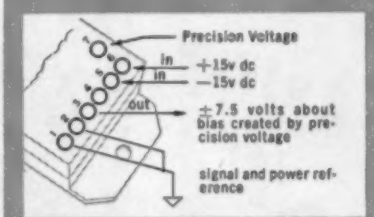


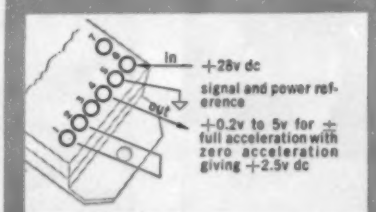
6 ways to solve CONTROL PROBLEMS with DONNER ACCELEROMETERS

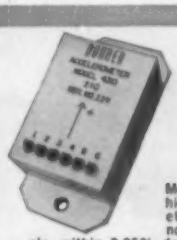
Donner 4300 series 0.1% transistorized force balance accelerometers can be connected in a number of ways to solve various control and measurement problems. Typical operational hookups for applications in telemetering, servo stabilization, gyro erection, acceleration switching, and short range inertial guidance are shown.



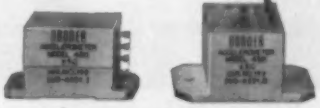








Model 4310 high output, high resolution accelerometer. Key specifications: non-linearity plus hysteresis, within 0.05% deviation from best fitted straight line; standard ranges, between ±0.05g full range and ±30g full range; resolution, better than 0.0002% full scale; weight, 3.5 ounces; standard output, ±7½v dc and/or ±1.5 ma full scale; options, biased output, fluid-filled units, and/or 28v dc operation; price, $450. f.o.b. Concord, California, options extra.



Split case version of the Model 4310 for use in limited space applications; electronics on right, sensing unit on left.

Donner engineering representatives are located in principal cities. For complete technical information, call your nearby representative or write directly to Dept. 056

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14

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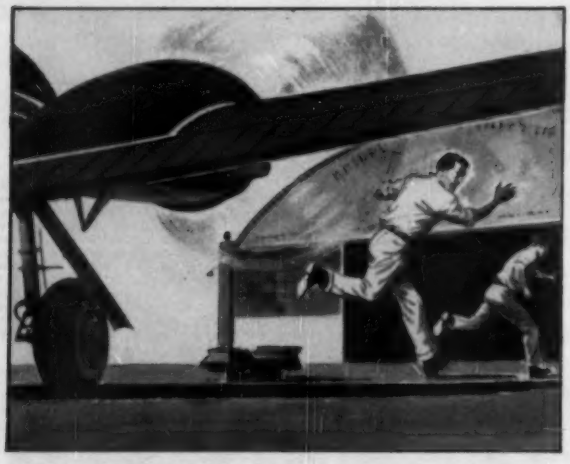
WING TIPS

DON'T CHANCE IT. Many a hot-shot pilot *thought* he could make it! You may think you know the area like the back of your hand, but don't chance it during hazardous weather. Minimum conditions for visual or instrument approaches and flight paths were set up for your safety – follow them!

AVOID "HEADACHES". Rough weather, grabbing brakes or any crash situation will cause injury of some sort if you're not strapped in securely. Check your seat belt and shoulder harness periodically for wear and anchorage security. Wear them and avoid "headaches"!



STAY "ON THE STICK". Failure to make corrections while taxiing has been the cause of countless groundloops and nose-up accidents. Be alert all the time – wind gusts, last-minute turns, overcorrections and near misses if not handled immediately can be costly. Remember, you're still flying 'til it's parked.

REMEMBER: For "Happy Flying"... look for the famous Esso Sign from Maine to Louisiana.

ESSO PISTON AND TURBO OILS. Up there, you rely on your engine and your engine relies on an oil for proper lubrication. Esso Aviation Oils excel in high-temperature stability and help prevent piston ring gumming and harmful carbon deposit formations. Whether your plane be large or small – prop or jet – look to Esso for the best possible lubricants for your aircraft.

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Highways or Skyways..."ESSO RESEARCH works wonders with oil"

Swiss Pilatus Porter Begins Flight Test

By Edith Walford

Stans, Switzerland—First prototype of the Pilatus Porter six-seater multi-purpose aircraft, built by Pilatus Flugzeugwerke A. G., has reached the flight test stage.

First production series of this model also is being constructed at the company's works here. A public demonstration of the Porter is scheduled for this year's Paris air show.

Design is based on the Pilatus P.4 type of which the firm produced only one prototype a few years ago. Price will be about $40,000.

The Pilatus Porter is a single engine, strut-braced high wing plane of conventional appearance.

Design features specified by the manufacturer are:

- **Short takeoff** and landing characteristics.
- **High rate of climb.**
- **High useful load.**
- **Multi-purpose suitability.**
- **Low purchase price** and low cost of operation and maintenance.

The entire plane is of light metal construction. Its two fuel tanks are located in the wings, one on either side of the fuselage. Trailing edge has landing flaps and ailerons.

Powerplant is a single six-cylinder, air-cooled Lycoming 340 or 260 hp. engine, at the purchaser's option.

The two large wheels of the main landing gear are fitted with low pressure tires and heavy duty brakes.

Pilot's seat is on the left of the fuselage immediately in front on the wing leading edge. There is room for one passenger alongside the pilot. From the back of the pilot's seat to the rear wall, the cabin measures 7.9 ft. long and 3.8 ft. in width.

Door is 5.3 ft. wide and fits flush with the floor of the cabin. It is made in two pieces and closes in the middle with no center support. It is a non-structural component; the plane can therefore fly without the door.

A hatch measuring 23½ x 35½ in. is built into the floor of the cargo area. Through this opening loads can be discharged or a camera can be fitted to the hatch. The hatch can be opened or closed from the cabin during flight.

Because of the rotation of the slipstream, the exhaust is located on the left and the cabin door on the right side of the fuselage. If the hatch is open or the plane is flying without a

ALL-METAL Pilatus Porter's wing trailing edge has landing flaps and ailerons.

TWO fuel tanks are in wings, on either side of fuselage. Note double door below.

door, the exhaust gas does not penetrate into the cabin.

The floor of the cargo area is fitted with rails onto which four single adjustable seats can be mounted. Behind these seats there is a compartment measuring 2.6 x 3.8 x 4 ft. for baggage.

There is a window in each part of the two-piece door and a third is installed in the opposite side of the fuselage giving the passengers good visibility. Adjustable heating and ventilating equipment is also provided.

An opening 1.6 ft. x 2.6 ft. in the rear wall of the cargo area permits the inspection of the fuselage interior as well as allowing transport of loads up to 16½ ft. long.

The special features embodied in the Porter give it a very versatile range of uses:

- **As a transport aircraft** capable of carrying up to 1,100 lb. or five passengers. The cargo area and wide door enable it to be used as a freighter for large loads.
- **As an ambulance** capable of accommodating two stretchers.
- **For agricultural application** with either dust or liquids.
- **For agricultural or military purposes,** such as the dropping of provisions or supplies of any kind, inspection of forest fires or other catastrophies.
- **As a military trainer** or for parachute practice. The plane can carry four paratroopers fully equipped.
- **As a transport plane** for policemen, their equipment and dogs and also for traffic control purposes.
- **For aerial photography.**

The aircraft can be fitted with retractable skis enabling it to take off or land on runways, grass strips or snow. Floats or floats with wheels can be supplied as extras enabling the plane to be used as either a flying boat or an amphibian.

Pilatus Porter

Powerplant
Air-cooled, six-cylinder Lycoming engine of 340 or 260 hp.

Propeller
Hartzell metal constant-speed propeller

Weights
- Empty weight: approximately 2,420 lb.
- Useful load: 1,545 lb.
- Gross weight: max. 3,970 lb.

General dimensions
- Over-all height: 9.8 ft.
- Over-all length: 34.8 ft.
- Over-all span: 50.0 ft.

Wing data
- Total wing area: 307 sq. ft.
- Wing loading: 13 psf.

Power loading
- With 340 hp. engine: 11.7 lb./hp.
- With 260 hp. engine: 15.2 lb./hp.

Instruments
Usual engine and flight type as well as elementary navigation instrumenis (clock, compass, horizon and turn and bank indicator)

Radio installations
Small receiving and transmitting set

Electric system
Power-operated generator, battery, external connection, starter, position lamps

Fuel
Integral fuel tanks in the wing, total contents 68.7 gal.

Performance
- Endurance: more than four hours with either a 340 or 260 hp. engine
- Range: more than 497 mph. (without headwind with either 340 or 260 hp. engine)
- Ceiling: 20,300 ft. (340 hp.) 14,800 ft. (260 hp.)
- Cruise speed: 124 mph.

Rate of climb
(with a full load of 3,970 lb.)
1,140 fpm. (340 hp. engine)
865 fpm. (260 hp. engine)

Takeoff distance (with 3,970 lb.)
approximately 328 ft. (340 hp. engine)
525 ft. (260 hp. engine)

Landing distance
approximately 328 ft.

Landing speed: 43.5 mph.

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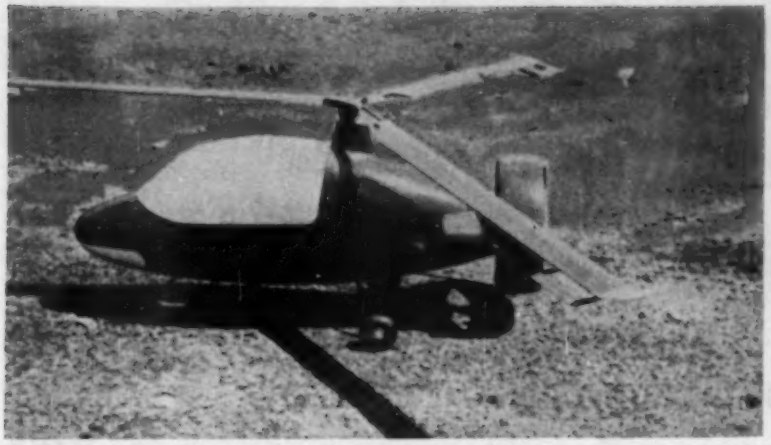

MODEL shows how Gyroplane's rear-mounted fan is ducted.

Gyroplane to Cost About $10,000

Georgetown, Ont., Can.—A group of former Avro Aircraft Ltd. design engineers have formed Avian Industries, Ltd., here to design and build a light personal rotary-wing aircraft designated Avian 2/180 Gyroplane. First flight is scheduled for September.

Avian Industries, which was formed with the aid of Georgetown Industrial Investments, Ltd., a local organization to encourage industry, is headed by Peter R. Payne.

He and 10 other former Avro engineers hold 52% of the stock.

Payne said the Gyroplane design is well advanced; the new company has purchased machine tools and set up a machine shop. The aircraft, he said, will cost about $10,000 and seat-mile cost is estimated at from three to four cents.

The Gyroplane design has been submitted to the Canadian army and received "favorable reception," Payne said, adding: "The company is not asking for any government subsidies, but is seeking a small fixed-cost army order because the need for such an aircraft apparently exists, and Avian believes that no one else can fill this need at the present time."

Because of its VTOL characteristics, the Gyroplane is independent of airfields or prepared landing areas. Maximum cruise speed will be about 150 mph. Payne said initial deliveries of certificated aircraft should begin in March, 1960, at the rate of 20 per month.

Gyroplane will be powered by a four-cylinder Lycoming engine of 180 hp., mounted 35 in. behind the rear seat. The engine is equipped with an Avian-designed muffler and powers a rear-mounted ducted fan. Avian said the duct enables reduction of propeller tip speed, cutting noise levels and reducing personnel hazards.

Gyroplane Details

Gross weight	1,600 lb.
Empty weight	1,000 lb.
Rotor diameter	26 ft.
Over-all length	14.6 ft.
Over-all height	7.9 ft.
Width in cockpit	35 in.
Maximum cruise speed	150 mph.
Maximum rate of climb	1,500 fpm.
Minimum flying speed	0 mph (vertical)
Normal fuel capacity	31 U. S. gal.
Normal range (still air)	450 mi.

The all-steel rotor is protected by wood-stabilized glass fiber skins and is said to require no attention other than inspection at major overhauls. Hinge points have Stellite bushings which require no lubrication. The three blades include servo-flap rotor controls, coupled with high offset flapping hinges, to increase dynamic stability, eliminate control vibration and produce light stick forces.

Payne said vertical takeoff to 200 ft., and vertical landing, is achieved by continuously storing compressed air in a glass fiber bottle at the rate of 5 bhp. during cruise flight, and releasing it at the rate of 250 bhp. through the rotor blades to nozzles at the tips, for VTOL.

Gyroplane flight differs from that of conventional aircraft in that the 2/180 cannot be stalled and gust response is about 1/10th that of a fixed wing aircraft.

The two-place cabin has a hinged plastic glass canopy and an entry door on the right side of the fuselage. The company said total annual costs, including basic operating costs plus storage, insurance and depreciation, would be $3,681 for 300 hr. utilization; $4,765 for 500 hr. and $5,850 for 700 hr.

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from ROBERT McCULLOCH

President

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Graduate Electronics Engineer or Physicist to perform theoretical electronic system analysis and design of new projects in the missile and electronic system field. He will be responsible for analyzing the customer's requirements and establishing basic as well as overall design parameters to be followed throughout the development of the project. The System Design Engineer will consider the various operational aspects of the system, including environments as well as collateral and concurrent effectiveness when used with related systems.

GUIDANCE DESIGN

Graduate Electronics Engineer or Physicist to perform design and development of circuits and components necessary to the optimum functioning of missile guidance systems. He will design transistorized pulse and video circuits for use in missile and other electronic system projects. He will be responsible for developing applicable circuitry, working from specified and/or general requirements laid down by the particular system concept as dictated by the needs of the customer. The field of emphasis will be in the development of radar techniques.

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Now expanding rapidly, Hughes is offering imaginative engineers a number of new positions. If you are interested in stimulating work with solid opportunity for personal and professional growth, we invite your inquiry. Please contact Mr. L. V. Wike at address below.

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BORGWARD Kolibri I hovers during flight test at Bremen. Helicopter has a top speed of about 100 mph.

Borgward Kolibri I Nears Production

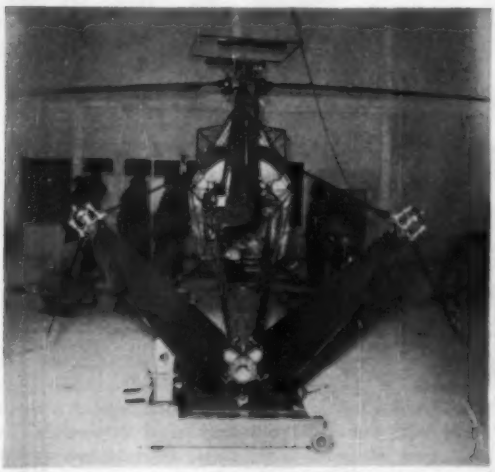
Bremen—Final configuration of Germany's first postwar helicopter prototype, Kolibri I, is now being type and flight tested at the Bremen airfield of automobile manufacturer Carl F. W. Borgward GmbH.

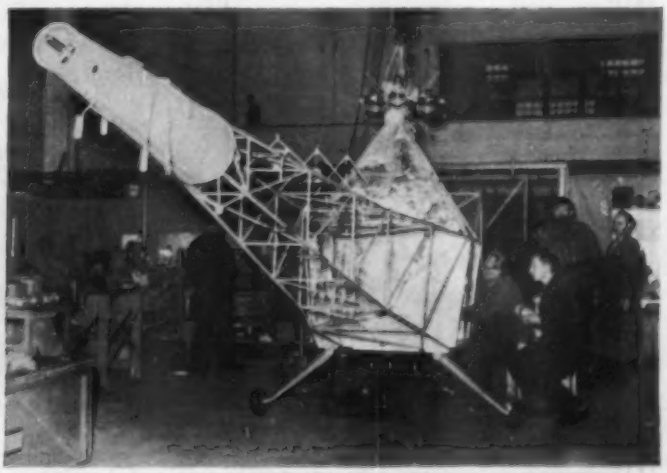
Construction of the second prototype is well advanced and will be followed by a series of production models.

Designed by Prof. Heinrich Focke, who has been working on helicopters for the last 25 years, the Kolibri I has been developed with the financial and technical support of Dr. Carl Borgward, head of the Bremen firm (AW Mar. 3, 1958, p. 296). Focke and his team of about 25 engineers have taken two years to develop the Kolibri I from drawing board to present status of ground testing and flight trials.

Designed from the start as a commer-

POWERPLANT is a Lycoming VO435-A1A developing 260 hp. Gross weight is 2,492 lb.





REAR VIEW of Borgward Kolibri (left) shows configuration of twin tail rotors. Aircraft is in early assembly stage at right.

NEW PROGRAM

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- Electronic packaging engineers
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Specifications

Equipped weight	1,720 lb.
Useful load	
Fuel	220 lb.
Oil	8.8 lb.
Pilot	170 lb.
Two passengers	340 lb.
Baggage	33 lb.
Gross weight	2,492 lb.
Performance	
Top speed (approx.)	100 mph.
Cruising speed (approx.)	87 mph.
Speed in backward flight	12 mph.
Speed in sideward flight	12 mph.
Landing speed from autorotation	31 mph.
Rate of vertical climb without ground effect	197 fpm.
Rate of inclined climb	786 fpm.
Hovering ceiling without ground effect	1,640 ft.
Normal ceiling without ground effect	13,100 ft.
Hovering ceiling with ground effect	492 ft.

cial venture, this helicopter meets the U. S. Federal Aviation Agency rotary-wing requirements which have been adopted by the German Ministry of Transport.

It is expected to sell for between $37,500 to $50,000 and will probably be marketed through the Borgward automobile organization.

First prototype was flight-tested at the beginning of this year (AW Feb. 21, p. 77).

Crosswind Gear Designed for Cessnas

Crosswind landing gear, designed to overcome "rollover" tendencies occasionally experienced by tricycle-equipped aircraft in windy or gusty conditions, has been granted a Supplemental Type Certificate by Federal Aviation Agency.

Developed by John H. Geisse, one of the key figures in the Department of Commerce's small plane development program in the mid-1930s, which resulted in popularizing tricycle landing gear, the new crosswind landing gear equipment is applicable for installation on the Cessna 172 and 175. In flight tests for FAA, a Cessna 172 fitted with the Geisse gear was operated from a hard-surfaced runway with direct crosswinds varying from 20 to 40 mph., all landings being made without eliminating drift and little correction for drift being required after breaking ground, the inventor notes.

The Geisse unit, which retails for $240 per set, consists of two hinge leaves joined by a one-inch bolt serving as a caster pin, shimmy damper springs on the bolt, and centering springs. One leaf is bolted to the Cessna single strut and the other to the axle.

Geisse points out that with tricycle landing gears, the rollover axis is typically at an angle of about 60 deg. to the tire side loads, whereas with tailwheel type landing gear the rollover axis is parallel to tire side loads. Loading on the tricycle gear is such that should a pilot feel he is in danger of ever rolling

Italians Build Private Jet

First prototype of two-place NEF 400 Cobra private plane, powered by an 880-lb. thrust Turbomeca Marbore II turbojet is nearing completion in Milan, Italy. Flight tests are expected to begin later this spring. A second prototype is in an advanced stage of construction. Interesting design feature of the Cobra (AW Jan. 19, p. 106) is use of aluminum alloy-covered plywood panels for covering the basic wood structure. Top speed of the Cobra is expected to be approximately 370 mph.

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over, often his reaction is to slow the airplane by applying brakes—this action may provide just the additional moment needed to complete a rollover, Geisse says. He reports that tests of a 172 fitted with the crosswind gear included doing figure 8s at speeds that would have resulted in rollovers without the equipment.

PRIVATE LINES

First deliveries of Hiller 12E three-place 305-hp. utility helicopter have gone to James M. Meade, Meade Helicopter Service, Houston, Tex.; and Robert Trimble of Aetna Helicopters, Medford, Ore., both of which will use the two aircraft on a three-month forestry service utility and fire duty contract in Arizona.

Internally air-conditioned pilot seats are featured in new Douglas DC-3 executive conversion development by Atlantic Aviation Corp.'s Wilmington (Del.) Division. New Castle County Airport-based company is sending its "Atlantic 3" on a nationwide demonstration tour this month.

Two new all-metal light aircraft are being developed by Morane-Saulnier: the MS-880 two-seater and a four-place version. MS-880 deliveries are scheduled for 14 months; rollout of the four-place model in 15-18 months. MS-880 is a low-wing side-by-side tricycle landing gear configuration with 90-hp. Continental. Fully aerobatic, it will have top speed of 133.4 mph., cruise speed of 115 mph. and four-hour endurance. Gross weight will be 1,280 lb., empty weight 780 lb. Wingspan will be 26 ft. 8 in.; length 20 ft. 4 in. and height 8 ft. 6 in. Price will be under $8,000 at the factory in France.

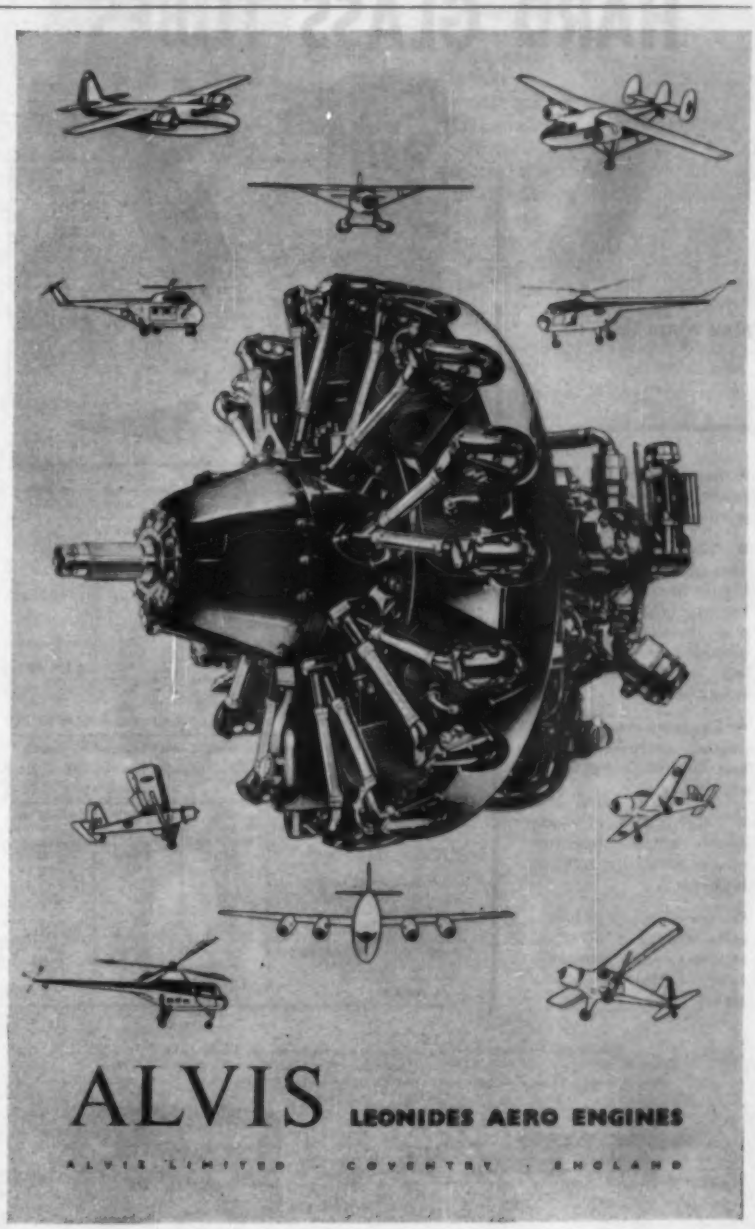
Production of executive Douglas B-26, named the Tempo, has been started by L. B. Smith Aircraft Corp., Miami, Fla., which has airplane number one on the line with completion scheduled for September. Program calls for both pressurized and unpressurized versions of the Tempo.

DC-3 Maximizer speed kits will be handled by Aviquipo, Inc., in Argentina, Brazil, Chile and Venezuela under a dealer agreement signed with AiResearch Aviation Service Division. In addition, the dealer will handle the AiResearch DC-3 aileron gap strip kit.

Metal skin conversions for Piper PA-20 Pacer and PA-22 Tri-Pacer developed by Skycraft Design, Old Star Airport, Langhorne, Pa., have been granted supplemental type certificate by FAA. Conversion covers wings, ailerons, flaps and fuselages and can be accomplished at Skycraft in less than two weeks, Al Snyder, general manager, reports. Metal conversion adds less than 40 lb. to basic weight of airplane.

There are some 75 agricultural aviation operators with a total fleet of 280 aircraft working currently in New Zealand, according to R. H. Scott, Department of Agriculture. Mr. Scott also notes that there are currently approximately 8,000 farm air strips in New Zealand compared with 5,716 in 1957. He also reports that of the 43.25 million farm acres in New Zealand, some 66% are located on terrain which is too steep to be properly cultivated by implements.

A $500,000 105-ft. x 220-ft. steel and masonry hangar will be built by National Distillers & Chemical Corp. at Teterboro, N. J., Airport on the east side of the field adjacent to Robinson Aviation. National Distillers signed a 20-year lease for the six-acre site with Port of New York Authority at a rental of $15,000 a year. The hangar is expected to be completed by Nov. 1 in time for delivery of National Distillers' Grumman Gulfstream turboprop executive transport.



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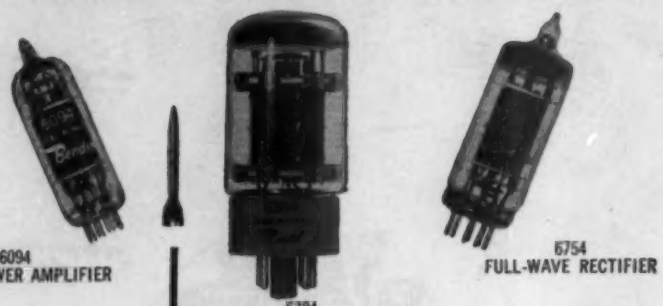

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Plate Voltage (Maximum DC)	300 volts	750 volts	350 volts
Screen Voltage (Maximum DC)	275 volts	325 volts	—
Peak Plate Voltage (Max. Instantaneous)	550 volts	750 volts	—
Plate Dissipation (Absolute Max.)	14.0 watts	30 watts	—
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Heater-Cathode Voltage (Max.)	±450 volts	±450 volts	±500 volts
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Maximum Seated Height	2¼"	2 15/16"	2⅛"
Maximum Diameter	⅝"	1 1/16"	⅝"
Mounting Position	Any	Any	Any
Maximum Altitude	80,000 ft.	80,000 ft.	80,000 ft.
Maximum Bulb Temperature	300°C	300°C	300°C
Maximum Impact Shock	500G	500G	500G
Maximum Vibrational Acceleration	50G	50G	50G

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WHO'S WHERE

(Continued from page 23)

Changes

Samuel B. Sherwin, manager, Ketay Department, Commack, N. Y., of the Norden Division of United Aircraft Corp. Also: **Wladimir Reichel,** Norden's chief of basic design, engineering manager of the Ketay Department.

AC Spark Plug Division of General Motors, Milwaukee, Wisc., has announced the following appointments: **Vincent E. Ryb,** manager—Titan ICBM guidance program; **Donald F. Ayres,** manager—Thor ballistic missile and Mace jet-powered missile guidance programs.

Anthony C. Cuomo, assistant manager, Missile Support Laboratory of Allen B. Du Mont Laboratories, Inc., Clifton, N. J.

Raymond E. Small, head of the newly organized Field Sales Operation, General Electric's Flight Propulsion Division, Cincinnati, Ohio. Mr. Small's organization includes the following district managers: **G. E. Grega**—operation planning, Evendale, Ohio; **W. O. Meckley**—European technical services office, Geneva, Switzerland; **S. E. Crites**—Northeastern district, New York City; **G. T. McTigue**—Southeastern district, Washington, D. C.; **A. T. Cavanaugh**—Central district, Dayton, Ohio; **J. J. Bingham**—Southwestern district, Dallas, Tex.; **W. F. Cronin**—Western district, Los Angeles, Calif.

Charles J. Lawson, Jr., director of manufacturing services, International Business Machines Corp., New York, N. Y.

Samuel W. Stewart, director of engineering and research, Gabriel Electronics Division of the Gabriel Co., Needham Heights, Mass.

Dr. Max T. Weiss, senior staff physicist of the microwave laboratory's electronics research department, Hughes Aircraft Co., Culver City, Calif.

Robert O. Wickersham, director, Program Management Staff, Systems Engineering Division of Space Technology Laboratories, Inc., Los Angeles, Calif. Also: **George S. Cherniak,** director of STL Flight Test Operations at the Atlantic Missile Range, Cape Canaveral, Fla.

Milton D. Van Dyke, professor of aeronautical engineering, Stanford University, Palo Alto, Calif., effective Sept. 1.

George Lind, company representative, Douglas Aircraft Co., Santa Monica, Calif., at the newly established liaison office at Strategic Air Command Headquarters, Omaha, Neb.

Richard H. Brooks, director of facilities, American Airlines, Inc.

Dan J. Tinius, senior project engineer, West Coast office, Los Angeles, Calif., of the Watertown Division of the New York Air Brake Co.

William B. Hebenstreit, program director for communication satellites, Systems Engineering Division, Space Technology Laboratories, Inc., Los Angeles, Calif.

Lycoming Division of Avco Corp., Stratford, Conn., has announced the following appointments: **Richard F. Howe,** assistant plant manager of the Stratford plant; **Immanuel Lichtenstein,** assistant to the president for planning.

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PUBLICATION DATE
APRIL 1, 1959

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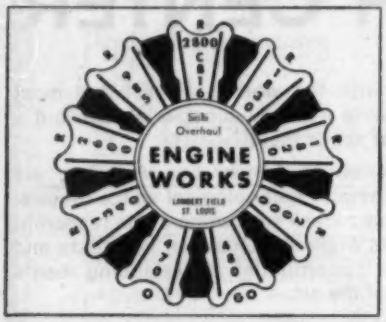

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LETTERS

Passenger Service

Let me congratulate you on your excellent editorial in the May 4 issue of AVIATION WEEK.

I have recently had some disagreeable experiences with the passenger service personnel of American and TWA airlines. Your comments accurately mirror my feelings on this subject.

RAY O. ROBERTS
Lt. Col., USAF
Holloman AFB, N. M.

Copilot Cancels

Effective immediately, please cancel my subscription to AVIATION WEEK. And, do not send me any literature requesting me to renew or make a new subscription. If at some time in the distant future I choose to again apply for a subscription, I will do so of my own free will, and I will not need any reminder from you.

Why am I doing this? If you are interested, the main reason, and the biggest reason, is that I object to your efforts to discredit the pilots in the airline profession. Secondary reasons include your attempting to make it sound as though the airlines are run by incompetent people, your unjust criticism of the CAA, FAA, and CAB, and your biased views and attitudes on certain issues, or on nearly all issues.

Capt. Gordon C. Blanchard of EAL expressed my view in part by his letter which appeared in Letters to the Editor of the May 4 issue (p. 214). He asked you, and I ask you, what are you trying to prove? All that he says in that published letter I concur with wholeheartedly. While I cannot stop you from using half-truths and the other methods you are using to discredit the airline pilots, I certainly do not see any reason why I should aid you in this campaign by subscribing to your magazine.

In the past I have always respected any McGraw-Hill publication. It was customary for McGraw-Hill publications to be unbiased, to report facts, and to make intelligent decisions and comments, without regard to political party, group involved, or issue concerned. However, in the case of AVIATION WEEK, these principles have been consistently cast aside over the past many years.

I firmly believe that any captain flying on any U.S. airline is far better qualified to make decisions as regards his flight than is the editor of your magazine. I cannot see how you can possibly attempt to second-guess those captains when it is quite obvious you are far removed from and not well acquainted with the issues at hand.

In one of your recent issues you reported about flight violations filed by flight engineers against pilots who had been on their flights (AW Mar. 16, p. 38). One point that your editors attempted to make was that because Eastern captains were using the throttles since our recent strike, that this fact was mainly responsible for the large number of engine failures Eastern had immediately after the strike (AW Mar. 23, p. 31). Now, it may be true that the captains took the throttles away from the engineers, and it may be true that Eastern had a large number of engine failures during January, 1959. However, if you had been interested in reporting all the truth, you might have given thought to a few other things concerning this. One, the captains have been using the throttles since, perhaps before, engineers ever came into being. Second, anyone concerned with aircraft operation knows that after a long period of idleness there will be a large number of engine failures and troubles. I don't care who maneuvers the throttles, this will be. But you obviously are not that closely concerned with aviation that you would know this fact, much less report it.

In that same issue (AW Mar. 16, p. 39) there was news on an engineer filing a violation against a captain who overflew Daytona Beach on an Electra flight. Perhaps it might interest you to know that there is a good possibility that the alleged incident happened on a non-stop flight between the points Miami-New York, scheduled non-stop, which the engineer did not know. But, in order to see just how stupid the engineer was the captain said to the engineer and copilot that he was not going to land at Daytona, as well he should not land. He found out how stupid the engineer was, and how stupid you are to be taken in by the propaganda put out by the FEIA, if that happened on the flight to which I am referring.

If you want to report news and facts, please do so. But, in the Braniff accident of a DC-7C at Miami International last year, did you look into the background of the engine that caught fire and caused the accident? If you did, your articles surely have not shown any sign of it (AW Jan. 26, p. 40, and Feb. 9, p. 103). Why not find out if an Eastern captain feathered that engine about one week before that fateful flight, find out if the feathering report was removed from the log, find out if Braniff corrected the troubles on that engine, find out what Wright engine folks had to say about the engine, think about what you find out, then see if you can still truthfully say that that accident was pilot error, a term you enjoy using. I know some about that accident, and if you don't know about these things I mentioned, then why not hire reporters to find out these things.

Your attacks on airlines in general are quite unjust. This business of constantly referring to the wait one must put up with when one calls for airline reservations. Do you think the airlines don't want to put a stop to that wait? You sound as if you think they do this intentionally. And, are the airlines the only place one must wait when calling on the phone or in person? Call long distance operator, call any business and ask for a certain office or officer, and see how long you must wait. Other business give you this old business of waiting on the phone and it is okay. But, when the airlines make people wait, then that is terrible; the airlines are apparently expected to be perfect. I daresay, that all delays of all types considered, the airlines give better service than any other business.

Another example of just plain foolishness that you put out appears in the editorial of the May 4 issue. "We recommend that airline executives mingle occasionally with a plane load of their passengers who have been dumped without notice due to equipment problems and listen to their realistic appraisal of various airlines' operational capabilities." (Italics mine for emphasis.) Now there is a jewel; how can people who generally know nothing about airplanes or the operation thereof possibly make a realistic appraisal? And, how much less qualified they are when they are emotionally confused. What do they expect, that after feathering an engine the plane should continue to its destination just to get the passengers there without delay? Many passengers think that an airline should have extra planes to cover all flights, and extra planes at intermediate points to be used in case the regular flight breaks down. That would be nice, except that there would be so much equipment needed that the airlines could not possibly begin to make money. And, judging from your criticism of the airlines, I believe that your knowledge and thinking about airline operation is not much better than those who are admittedly ill-informed.

I could write more about the above and related items, but I think by now you get the point. When you start printing facts, and opinions based on facts with logical deductions used to arrive at a conclusion, and when you stop being swayed by any groups or causes, and when you stop your unjust criticism of the pilots, the airlines, and others, then I will reconsider, and think about subscribing to your magazine. Until that time, don't call me, I'll call you.

Your former supporter, and now your enemy,

KENNETH L. DEAN,
Copilot, Eastern Air Lines
Hialeah, Fla.

P.S. Perhaps you will see fit to do with this letter as you have with other facts, quote part of it and then use my own statements to try to make them into something I obviously did not mean. For AVIATION WEEK this type of thing is not new.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Guidance Sales

Your very interesting and informative story of April 6, "Inertial Guidance Sales Show Fast Climb," contained a slight inaccuracy in the table on p. 53.

Manufacturer of the B-70's inertial guidance system is indicated as NAA Autonetics. IBM actually is the system manufacturer whereas NAA Autonetics manufactures the inertial platform. We are subs to NAA on the over-all system.

WILLIAM F. SCHILLING
Manager of Communications
International Business Machines Corp.
Military Products Division
New York, N. Y.

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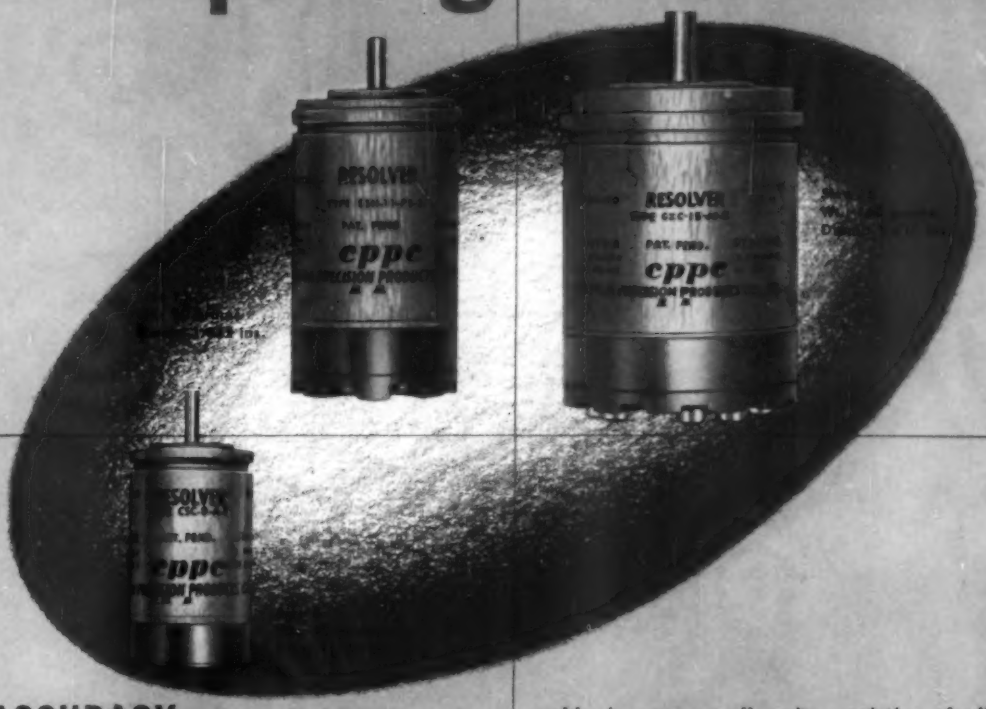

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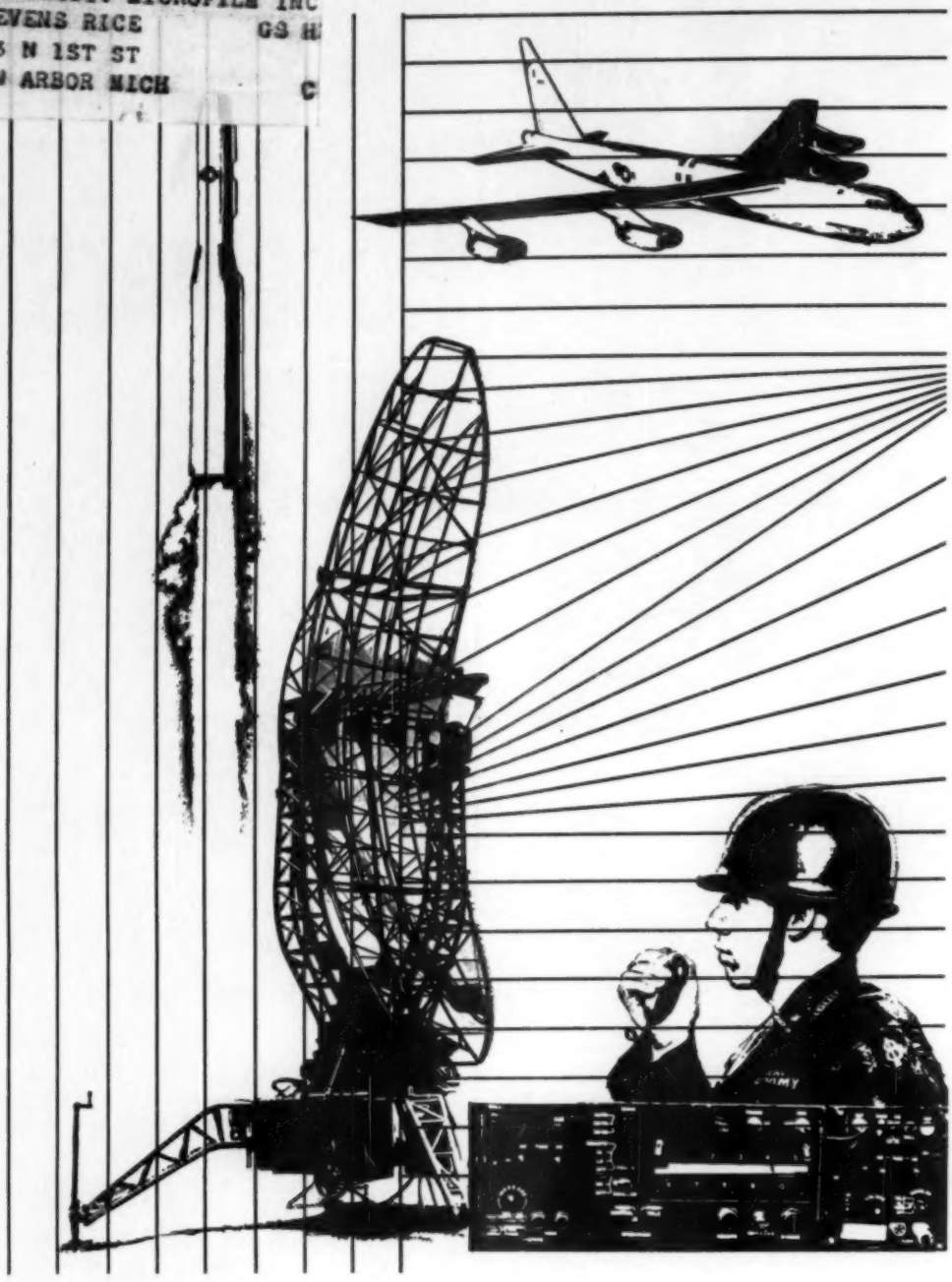

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